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VITAL and HEALTH STATISTICS

ANALYTICAL STUDIES

Infant and Perinatal Mortality in England and Wales

Analysis of long-term and short-term trends in infant mortality by age at death, sex of child, cause, and geographic factors; stillbirth and perinatal mortality trends; role of various risk factors including maternal age and parity, multiple pregnancy, prior fetal loss, maternal stature, illegitimacy, and socioeconomic status; discussion of maternal and child health services.

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OFFICE OF HEALTH STATISTICS ANALYSIS

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FOREWORD

This report is one of a group of analytical studies designed to delineate the perinatal and infant mortality problem in the United States. Of particular interest is the fact that the United States is not alone in experiencing an important change in the infant mortality trend. For a number of other countries as well, infant mortality is no longer declining at its former pace.

Although our primary concern is with the problem of perinatal and infant mortality in the United States, it was felt that much could be learned from the experience of other developed countries with advanced medical systems. In several of these countries, levels of infant mortality which are lower than that in the United States have been achieved. The National Center for Health Statistics arranged with a number of investigators to prepare comprehensive studies on perinatal and infant mortality in their own countries. Earlier reports evolving from these investigations appear in Series 3 of *Vital and Health Statistics* published by the Center:

No. 4 Infant and Perinatal Mortality in the United States
No. 5 Infant and Perinatal Mortality in Scotland
No. 6 International Comparison of Perinatal and Infant Mortality: the United States and Six West European Countries
No. 8 Infant Mortality Problems in Norway
No. 9 Infant and Perinatal Mortality in Denmark
No. 11 Infant Loss in the Netherlands

The present report for England and Wales completes this particular group of reports on infant mortality.

The manuscripts from the individual countries were prepared for publication under the technical supervision of Helen C. Chase, Dr. P.H. The detailed technical editing was shared by Dr. Chase who had primary responsibility for the reports from the United States, the Netherlands, and England and Wales and Miss Elizabeth W. Curran who had primary responsibility for the reports from Scotland, Norway, and Denmark. The methodology, findings, and conclusions are those of the investigators.

Iwao M. Moriyama, Ph.D.
Director
Office of Health Statistics Analysis

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IN THIS REPORT detailed statistics are provided on infant and perinatal mortality rates from 1930 through 1963 in England and Wales. The analysis focuses on the lack of sizable decreases in these rates during the 1950's and 1960's, and the effects of various biologic and environmental parameters of infant loss. Health services available for both mother and child are fully described. The role of the obstetrician and pediatrician in relation to the perinatal and infant loss problem in England and Wales is reviewed in light of the findings of the British Perinatal Mortality Survey of 1958, and suggestions for maternal and child care are made.

In the last 30 years the infant mortality rate in England and Wales has fallen 65 percent from 60 in 1930 to 21 in 1963. The greater part of the fall has been in deaths during later infancy. In 1963 nearly 60 percent of the reported perinatal deaths occurred before the birth of the child. A further 25 percent occurred during the first day of life. The most frequent pathological findings among perinatal deaths are intrapartum anoxia and/or cerebral birth trauma which are potentially avoidable in the future. The postneonatal death rate has increased 11 percent since 1961. The major resistant problems of infant mortality are immaturity, pneumonia, and congenital malformations.

To accelerate the rate of decline in perinatal mortality, increased emphasis on the problem of infant mortality through further pediatric investigation and increased expert prenatal and intranatal obstetric care is urged.

INFANT AND PERINATAL MORTALITY IN ENGLAND AND WALES

Katherine M. Hirst, O.B.E., M.B.B.S., D.P.H.; Neville R. Butler, M.D., F.R.C.P.; and M. J. R. Dawkins, M.D., M.R.C.P.[a]

TRENDS IN INFANT MORTALITY AND STILLBIRTHS, 1930-63

England and Wales has, during the current century, shared with many other countries the experience of great reductions in the death rate associated with birth and infancy. Throughout the latter half of the 19th century the infant mortality rate remained more or less stationary at about 150 deaths per 1,000 live births. In the 20th century the rate fell by 85 percent, from 137.8 in the quinquennium 1901-5 to 21.1 in 1963 (table 1).

The greater part of the fall has been in deaths during later infancy. In the early years of the century postneonatal deaths accounted for two-thirds of the total infant mortality. By 1930, as a result of a more rapid fall in postneonatal than in neonatal deaths, these two components of the infant mortality rate were approaching equality. With the continuation of these trends, the original position reversed, so that from 1950 onwards it is neonatal deaths that have formed approximately two-thirds of the total.

The position is similar within the neonatal death rate itself. This rate has fallen by 65 percent, from 40 in 1906 to 14 in 1963. But again the greater contribution to the fall has been in deaths during the latter part of the neonatal period. In the early years of the century the proportion of early to late neonatal deaths was 3 to 2; by 1930 it was about 5 to 2 and by 1963 it was 12 to 2 (table 2).

For stillbirths[b] reliable figures are not available until after 1927, the year in which stillbirths became registrable. Prior to this date, incomplete information which was derived from notification of births to Medical Officers of Health indicated that, at least from 1918, stillbirths had not been decreasing. In 1928, the first complete year of registration, the stillbirth rate was 40; by 1963 it had fallen by 58 percent to 17. The consistent decrease began in 1936, closely following the start of the consistent decrease in the maternal mortality rate, which had reached its highest point in 1934 (table 1). But whereas the stillbirth rate has fallen by 57 percent since 1936, the maternal mortality rate has fallen by over 93 percent since 1934.

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[b]The World Health Organization recommends use of the term "fetal death" for all pregnancy terminations which show no evidence of life after complete expulsion or extraction from the mother; in European vital statistics, the term "stillbirth" is used to denote such terminations at 28 or more weeks of gestation.—Ed.

The relatively slow reduction in early neonatal deaths and stillbirths is reflected in the perinatal mortality rate which in 1930 was 62 and was only little more than halved to 29 by 1963, whereas during this period the total infant mortality rate fell by almost two-thirds.

Thus the overall picture of perinatal and infant mortality in England and Wales during the current century is one of a dramatic fall in deaths in later infancy, but one in which the diminishing stillbirths and neonatal deaths (especially in the first week) are still far short of an improvement comparable with that of later infancy.

In the first 30 years or so of this century, it is likely that the fall in the infant mortality rate was the outcome of broadly based measures directly or indirectly affecting infant health. These may be summarized briefly as improvement in general hygiene and housing, better nutrition, more specialized training of doctors and nurses in obstetrics and pediatrics, and better education, especially the education of mothers in the care of young children.

During this period there was considerable legislation bearing on infant health of which the most important items were the Midwives Act of 1902 and the Maternity and Child Welfare Act of 1918. The Midwives Act established midwifery as a profession. Thereafter no one but a certified midwife was permitted to attend, for gain, on a woman in childbirth (except, of course, doctors). The Act also set up the Central Midwives Board to control the training and practice of midwives. Following the creation of this specialized branch of the nursing profession, the great majority of normal confinements for the past 60 years have been undertaken in this country by skilled and well-trained midwives.

The Maternity and Child Welfare Act gave local authorities power to make arrangements for the care of expectant and nursing mothers and of children under 5 years of age, subject to approval by the Ministry of Health. "Care" in this sense implied preventive and educational work for health but did not include domiciliary medical care. The Act stimulated the widespread development of maternity and child welfare centers and advisory home visiting of mothers and children by qualified Health Visitors, as well as many ancillary schemes concerning nutrition, home help in confinement, day nurseries, convalescent care, and so on. Much of the Act built on work that had already been started by voluntary organizations and local authorities. The nationwide development of the maternity and child welfare services was the foundation of great improvement in child care and child health during the current century.

Following the rapid fall in the death rate and the general improvement in child health, there has been, during the past 30 years or more, a gradual change in the approach to the problem of infant mortality. The broad approach based on education, nutrition, hygiene, and medical and nursing services is still needed to maintain the standards of good health for the whole infant population. It is now increasingly supplemented by more intensive study of the problems of special groups, special factors, or particular age periods, deploying, as it were, shock troops or resistant focuses. Such examples may be mentioned as the study of the medical and nursing needs of premature infants and the medicosocial problems of illegitimate children.

In the field of perinatal mortality, a fruitful line of attack lies in the indentification of high-risk groups by the study of biologic, geographic and social factors. An intensive demographic approach has been made possible at a national level through the supplementation of official vital statistics by more extensive background data gathered on many thousands of pregnancies throughout England, Scotland, and Wales during the 1958 British Perinatal Mortality Survey of the National Birthday Trust Fund. This Survey gathered data about the obstetric circumstances and the sociobiologic background of 98 percent (16,994) of the single births occurring in England, Scotland, and Wales during March 3-9, 1958, and of 94 percent (7,117) of the stillbirths and neonatal deaths in March, April, and May 1958. Further, with increasing medical knowledge especially in perinatal pathology which was also investigated at a national level in the British Perinatal Mortality Survey, there has been increasing accuracy in identifying pathologic causes in perinatal and infant mortality. Thus, as some of the previously little-understood or ill-defined

causes of death are elucidated, the possibility of a specialized approach to resistant conditions increases.

This report deals with the trends of mortality during the past three decades, especially since 1950, and in so doing will particularly identify and discuss the resistant elements in perinatal and infant mortality in Britain. Data are primarily taken from reports of the Registrar General, the Ministry of Health, and the British Perinatal Mortality Survey. Greater details concerning definitions are found in appendix I, registration and notification procedures in appendix II, and health services in appendix III.

Infant Mortality by Age

Table 2 gives the mortality rates in certain age groups for all infants from 1930 through 1963. Figure 1 shows the trends of mortality during approximately the same period and in the same age groups for all infants (and also for stillbirths) with quinquennial averages expressed as percentages of the rates for 1929-33. Particularly notable is the increasing importance of the contribution of early neonatal death, especially first-day death, to infant mortality. While the early neonatal death rate fell by little more than two-fifths from 1930 to 1963, the late neonatal and the total postneonatal death rate fell by nearly four-fifths.

Although by 1963 the first-day death rate had been diminished by nearly one-third since 1930, it has been virtually stationary since 1950. For the remainder of the first week the rate has maintained, on the whole, a steady fall. For late neonatal and postneonatal deaths, figure 1 demonstrates the slowing down, or reversal, of improvement in the war years and in the 1950's.

The trends of age-specific mortality and the conditions influencing these trends have shown differing characteristics in successive decades since 1930 and may be conveniently considered in more detail in these periods.

1930 Through 1939

In this decade the fall of the total infant mortality rate from 60 to 51 infant deaths per 1,000 live births was entirely due to reduction of the deaths in later infancy, especially at 6-11 months. Neonatal mortality improved only slowly in the later years of the decade. Factors contributing to the improvement in postneonatal mortality were undoubtedly the well-organized child welfare services throughout the country, the increasing use of immunization against infectious diseases, and the development of chemotherapy in the latter part of the decade.

These favorable developments in preventive and curative medicine offset to some extent the difficulties of a period of economic depression and high unemployment in the late 1920's and early 1930's. However, they operated mainly from the later neonatal period onward and so could have little effect on the early weeks of life.

The neonatal mortality rate showed little change in the early 1930's and did not begin its slow but steady downward trend until 1934, when the effects of the economic depression were beginning to recede. The improvement was accelerated by measures which were primarily directed toward the reduction of maternal mortality, but which also affected the closely related problems of neonatal mortality. The more dramatic appeal of rising maternal mortality in the 1920's and early 1930's aroused a greater interest than might have been aroused by the stationary neonatal mortality rate, hidden as it was in the falling total infant mortality rate. Maternal mortality was intensively studied by many organizations and committees, notably the Departmental Committee on Maternal Mortality and Morbidity set up by the Ministry of Health. Its recommendations, published in 1930 and 1932, met with a ready response. Some of the administrative consequences were that the General Medical Council raised its requirements for obstetric training in medical schools; the Central Midwives Board took similar action in relation to the training of midwives, adding, among other things, instruction in the care of the newborn; local authorities and hospitals increasingly adopted the recommended higher standards relating to personnel, premises, and practice in prenatal clinics; and Parliament passed the 1936 Midwives Act which set up a nationwide service of salaried midwives to be paid by their local authority and placed on the

local authorities the duty of ensuring that there were sufficient midwives for the needs of each area. These measures, together with a notably heightened interest in all aspects of prenatal and obstetric care, not only reduced maternal mortality but also neonatal mortality.

Concurrent with advances in prenatal and obstetric care, there was increasing study of the needs and care of premature or low birth weight babies. The first hospital unit devoted solely to the care of premature infants was opened in 1931 at the Sorrento Maternity Home in Birmingham and was soon followed by others. These units provided not only postgraduate experience for doctors but also training courses in domiciliary and hospital care for midwives. Local authorities increasingly appointed these specially trained midwives to nurse selected cases of prematurity at home in conjunction with family doctors. The rapid development of this specialized branch of pediatrics undoubtedly influenced neonatal mortality during this and subsequent decades.

1940 Through 1949

In this decade, infant mortality was influenced at first by the effects of war. The rate rose sharply in 1940 and 1941 but, in contrast with the previous decade, it was in later infancy that the effect was greatest. The mortality rate at 1 through 5 months rose from 14.9 in 1939 to 21.0 in 1941 and at 6 to 12 months from 7.3 to 10.1, whereas neonatal mortality was little affected.

The direct effect of war (i.e., death by enemy action) was statistically slight, no doubt largely because of the evacuation of children from the target areas. The highest infant mortality rates due to "operations of war" were 0.3 and 0.4 in 1940 and 1941. In the remaining war years this rate was never above 0.1.

It is impossible to assess accurately the indirect effect of the many disturbances of war, but three factors must undoubtedly have affected the health of young children, namely, the widespread disruption of family life, the migration and mingling of large groups of the population evacuated from the cities to safe areas, and the dislocation of the normal health services.

Under the Government Evacuation Scheme over 4 million people, mainly children, were evacuated from target areas to safer areas in the country. As the conditions of war changed, there was an ebb and flow of evacuation. It is estimated that an additional 2 million people moved from their homes under private arrangements and a further million with the dispersal of certain industries and Government departments. Thus, throughout the war there was a constant mingling of classes and cultures. Inevitably, there were at first widespread improvisations to meet a situation which, though planned in advance, had never before been experienced. For the many families who elected not to be evacuated (or who returned from evacuation) there were long periods of hazardous nightly congregation in large air-raid shelters, particularly in the autumn of 1940 and again in the following spring.

In the hospitals, the complexities of reorganization to meet the demands of war made it inevitable that the needs of civilians had low priority until experience revealed the extent of other needs. In addition, thousands of hospital beds in London and other cities were lost as the result of bomb damage.

In the public health and social welfare services almost the entire personnel of many local authorities were at times diverted wholly from their normal duties to organize and operate the Civil Defense Service and the evacuation scheme. A heavy burden fell on rural and smaller urban areas faced with the influx and reflux of the most vulnerable groups of the population.

Family doctors not only found their work increased by recruitment of doctors to the armed forces and by the difficulties of hospitalization for the civilian sick, but were in addition widely absorbed into part-time work in the Civil Defense Service and in the multitude of medical problems arising out of evacuation.

This dislocation of the health services together with the widespread disruption of family life and the migrations and congregations of the population, especially children, was reflected in the temporary rise in infant mortality. Indeed in all the circumstances it may be a matter for surprise that the rise was not greater and of longer duration. As expected, the rise was chiefly due to an increase in deaths from infective conditions, especially respiratory diseases, measles, and whooping cough, but there was no major explosion of infectious disease during these years.

Neonatal mortality during 1940 and 1941 was very little affected. There was a slight rise in the late neonatal death rate from 7.1 in 1939 to 8.3 in 1940 and 1941, but the slow downward trend of the early neonatal death rate was barely halted. The explanation of the relative immunity of the neonate to the effects of war in 1940 and 1941 may lie in the interaction of several factors. The most potent were the administrative measures to protect the coming generation in times of danger as expressed in the Government's food and evacuation policies.

In the food rationing scheme, mothers and young children had high priority from the outset. From July 1940 expectant and nursing mothers and young children were supplied with at least 1 pint of milk daily, or the equivalent in national dried milk for babies. This milk was supplied at cheap rates or free in needy cases. In 1941 adequate supplies of free or low-cost vitamin supplements were added in the form of an orange juice concentrate under lend-lease arrangements with the United States of America and national cod-liver-oil compound, or tablets of vitamins A and D for mothers. National dried milk and margarine, the principal dietary sources of fat during the war, were both fortified with vitamin D. Young children also had priority in the small and variable supply of eggs. These priority rations of essential foods played a vital part in maintaining nutrition for mothers and babies and undoubtedly safeguarded infant health from intrauterine life onward, during the years of serious food shortage.

From the outbreak of war expectant mothers were included in the evacuation scheme, and in their case the arrangements proved of value not only as a safety measure. The mothers went to hostels and emergency maternity homes in the reception areas about 1 month before the expected date of confinement. Even when the air attacks diminished, these arrangements were continued as a means of relieving the shortage of maternity beds and personnel in the cities. Thus, throughout the war, many mothers who were in need of protection from physical danger, or who might have difficulty in arranging for their confinement, had the opportunity of rest, supervision, and confinement in circumstances where they and their newborn infants were buffered from the worst disturbances of war. Moreover, they were mainly mothers from the more congested urban areas, a group vulnerable to infant mortality.

Another favorable influence on neonatal mortality was the persistence of the strong current of improvement in prenatal and obstetric care that had been stimulated in the previous decade. Doctors and midwives who had experienced higher standards of training initiated in the 1930's were coming into practice. The last of the Government reports arising out of high maternal mortality was published in 1937, and appreciation of the value of skilled maternity care was enhanced by the special problems arising out of the war.

Further, many of the women who were bearing children in the early 1940's probably had some constitutional advantages over mothers of earlier years. There was a rapid rise in the marriage rate in the autumn of 1939 and through 1940, reaching a figure higher than any in the previous 100 years. The rise was especially marked for younger women. For the first time in the 20th century the marriage rate of women of 20-24 years exceeded that of women 25-29 years of age. These younger women not only had youth in their favor but also had passed through their infancy and childhood when the nutrition of children was improving rapidly. In particular, their infancy was a time of intensive attack on "summer diarrhea" and of research into the causes of rickets. Knowledge of the value of breast feeding and of hygiene and principles of artificial feeding was disseminated, mainly through child welfare centers, where dried milk was widely supplied at reduced prices. The infant mortality rate from diarrheal diseases fell from 20 in 1911-15 to 9 in 1916-20. Rickets was also widely attacked through the teaching of dietetic principles, the supply of cod-liver oil, and prophylactic use of ultraviolet light at the child welfare centers.

Thus, among women marrying in late 1939 and in 1940 (many of them presumably coming to childbearing in 1940 and 1941), there were more younger women than previously, and presumably these younger women were better nourished in their own infancy and fewer of them suffered from postrachitic pelvic contractions. All of these factors would tend to counteract any adverse effects of war conditions on neonatal mortality.

After 1941, infant mortality fell rapidly during the remainder of the decade. The fall was

interrupted only in 1945, when the end of the war brought its own problems. The cumulative effects of war brought an almost worldwide food shortage. In addition, in this country, families were returning to overcrowded conditions in war-stricken areas (not only due to housing damage but also to the complete cessation of new building for 6 years), many hospitals were still at least partially out of action, there was a grave shortage of medical and nursing personnel pending demobilization, and the birth rate was rising. All these factors combined to halt the fall of the infant mortality rate in 1945.

Apart from this brief check, the fall in the infant mortality rate was remarkable. Between 1941 and 1950 the total rate was halved (from 60.0 to 29.6) and in this period the early neonatal, late neonatal, and postneonatal death rates fell by approximately 27, 60, and 64 percent, respectively. This was achieved in a time of total war, followed by years of national financial stringency and food shortages and with the birth rate rising by 1947 to a higher level than at any time in the previous 30 years. The rapid fall in the infant mortality rate was in part due to the return to the previous pace of improvement as the country became adapted to the disturbances of war, in part to the continuance of priority food rationing throughout the war and for several further years, but above all, in the latter part of the decade, to the great advances in medical knowledge at this time. Antibiotic therapy, which was not available in this country for general civilian use until after the war, stands out as the most potent new weapon. In many fields, medical research yielded other new or improved weapons that contributed to the saving of infant life: the further development of chemotherapy, the widening range of immunization, the elucidation of the cause of hemolytic disease of the newborn, the improvement in the techniques of blood transfusion, and the discovery of the relationship between congenital malformations and maternal rubella.

It is probable that other less demonstrable medicosocial factors were also influencing the infant mortality rate, such as increasing education in child care and the beneficial effect of full employment arising out of the war, but there can be little doubt that the most potent factor was the enhanced power of the direct medical attack on disease. The main impact was on infective conditions that chiefly affect the late neonatal and postneonatal periods.

1950 Through 1963

During the 1950's infant mortality continued to fall, but at a much slower pace than in the 1940's. The rate fell by 27 percent from 30 in 1950 to 22 in 1959, in contrast with the fall of 50 percent from the peak of 60 in 1941 to 30 in 1950. The rapid recovery of those years came to a temporary halt in 1951. Thereafter improvement was resumed relatively slowly throughout the remainder of the decade and the early 1960's.

The slowing down of the pace of improvement is apparent in all age groups, except 1-6 days (fig. 1). Even in this group, there was a temporary halt in the trend around 1950 (table 2) which is masked by the quinquennial character of figure 1.

The outstanding feature of this period is the virtual standstill of the first-day mortality rate, which has scarcely altered since 1950, fluctuating around 7.5. At the beginning of the 1950's, first-day deaths accounted for about one-quarter of all infant mortality; by the end of the decade the proportion was approximately one-third. The cessation of improvement in such a large fraction of the total has put a strong brake on the fall of the infant mortality rate.

Improvement in the late neonatal mortality rate slowed down a little in the 1950's, but by then it had already reached the low figure of three infant deaths per 1,000 live births. In postneonatal mortality the improvement in the rates not only slowed down in the mid-1950's but by the 1960's these rates had begun to show an upward trend.

Thus, although the infant mortality rate in 1963 reached the lowest figure ever recorded in this country, improvement has been slower or absent in the last 10 or 12 years in all age groups except 1-6 days. First-day deaths stand out as the most resistant and also numerically the major problem. Postneonatal deaths, though far fewer in number, present the new problem of a rising trend. Trends of these rates in recent years will be considered in more detail in relation to causes of death, factors influencing variability in the mortality rates, and the trend of the stillbirth rate.

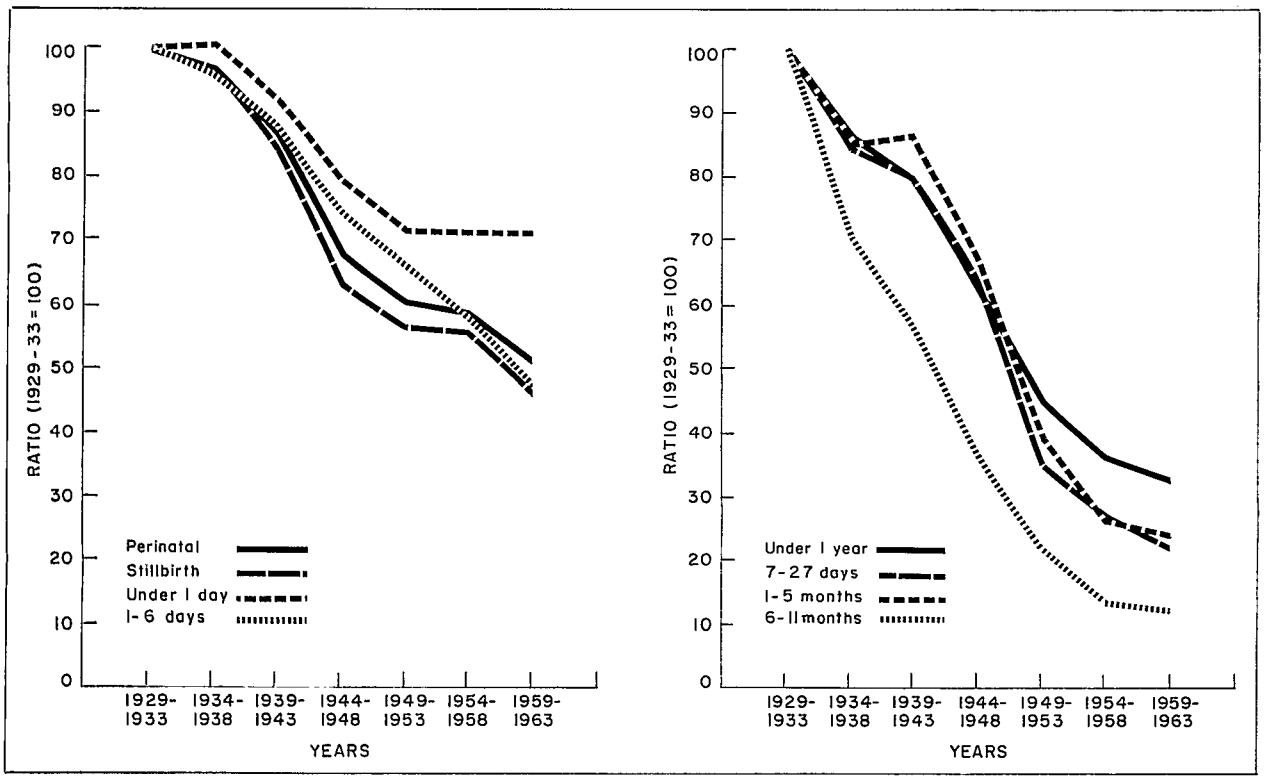

Figure 1. Ratios of quinquennial stillbirth, perinatal, and infant mortality rates to rates for the period, 1929-33: England and Wales, 1929-63.

Infant Mortality by Sex

For many years, certainly since the third decade of this century, the ratio of the male to the female death rate in the first year of life has varied very little. The excess of the rate for males over females has fluctuated around 30 percent. But the sex ratios have changed in the different age groups (table A). Broadly, there has been a tendency for the index of male to female rates to rise in the early neonatal period and to fall in the postneonatal period, while in the late neonatal period the ratio has not changed appreciably.

The high proportion of male deaths at 1-6 days has remained a constant feature over the years (table 3). This was due mainly to the high male mortality from two of the most frequent causes of death at this age—birth injury and postnatal asphyxia, for which the sex ratios in 1959-61 were 185 and 165, respectively (tables 4 and 5). Two much less frequent causes, pneumonia and congenital malformations of the heart also contributed. For these last two conditions, the sex ratios for infant mortality at 1-6 days were, respectively, 180 and 158 in 1959-61. Birth injury also showed a somewhat higher than average

Table A. Sex ratios in infant mortality, by age at death: England and Wales, selected years, 1936-62

Age at death	1960-1962	1950-1952	1940-1942	1936-1939
	Males per 100 females			
Under 1 day--	131	128	125	124
1-6 days-----	143	146	139	132
7-27 days----	121	121	120	123
28 days-2 months----	125	136	140	144
3-5 months---	119	118	130	132
6-8 months---	106	120	123	126
9-11 months--	111	107	117	122

sex ratio in first-day mortality (148), but in this age period the high sex ratio is offset by the lower sex ratio for congenital malformations of the central nervous system.

The reduction of the male excess in mortality during the postneonatal period stems from the marked fall in mortality from all causes except congenital malformations. Malformation of the central nervous system is the only group of deaths in which the female rate is consistently higher than the male. As deaths from other causes have decreased, mortality from congenital malformations, with its high component of female deaths, has formed an increasingly larger proportion of postneonatal deaths with consequent reduction of the sex ratio for postneonatal deaths.

Trend of Stillbirth Rate

In 1928, the first complete year of stillbirth registration, the rate was 40 per 1,000 total births. It remained at 40 or 41 for 9 years, but dropped to 39 in 1937; since then the rate has fallen almost every year to 17.2 in 1963 (table 1).

Although the fall has been almost continuous, the pace of improvement has not been consistent. It was relatively slow in the late 1930's, much more rapid in the early 1940's, then became almost stationary in the early 1950's. The fall quickened again after 1957 though not quite so much as in earlier years.

The trend of the stillbirth rate paralleled that of first-day mortality until about 1957, when the resumption of the decline in the stillbirth rate was not matched by a decline in first-day deaths (fig. 1). The favorable medical, environmental, and biologic factors that influenced neonatal mortality in the 1930's and 1940's were primarily operative prenatally and intranatally and thus were even more favorable in their effect on stillbirths.

Mention should be made at this point of two circumstances relating to death or stillbirth certification which may have had some artificial effect on the trends in recent years. Prior to 1948, financial maternity benefits were relatively small in amount and applied to a limited group of women, but after that date, substantial maternity benefits became payable to all women in childbirth. When little or no financial consideration arises in borderline cases of a birth around the 28th week of pregnancy, the doctor or midwife may be inclined to spare the parents the distress of registration and burial and may regard the outcome of the pregnancy as an abortion.[c] When substantial financial consideration is involved a borderline decision might be in the opposite direction. In the British Perinatal Mortality Survey[1] in one month (March 1958) 11 abortions had in fact been registered as stillbirths. Thus, in 1958, the effect of incorrect registration was evidently trivial, but in earlier years the situation may have occurred rather more frequently, though its effect was probably never more than marginal.

The interpretation of the definition of "stillbirth" will also have had some influence. Doctors and midwives were free to put their own interpretation on the words "or show any other signs of life" in the statutory definition of stillbirth. However, it has been traditional to regard as a stillbirth any fetus that does not breathe, that is, in effect, to disregard the words "any other signs of life." The definition of stillbirth approved by the World Health Organization (WHO) in 1950 particularized the other evidence of life as "beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles." The WHO definition was not adopted in this country but received some publicity and provoked discussion. There was also discussion during the 1950's of the pros and cons of certifying the causes of stillbirth (eventually begun in 1960) and rapid advance in the study of perinatal pathology. These developments focused attention on the precise definition of stillbirth and no doubt started a trend of regarding as liveborn some infants that previously would have been considered stillborn. In 1960, supplies of the new stillbirth certificate (with cause of death) were issued to doctors and midwives and the advisory notes therewith contained not only the statutory definition of stillbirth, but also, for the first time, a statement that "a child which has breathed or shown any other sign of life, such as beating of the heart, pulsation of the umbilical cord, or definite move-

[c] As used in this publication "abortion" is the equivalent of the World Health Organization Class "Early and intermediate fetal deaths" (fetal deaths of less than 28 completed weeks of gestation).—Ed.

ment of voluntary muscles is considered as live-born for registration purposes." This definite guidance on the interpretation of the English definition undoubtedly increased the trend for some stillbirths to be transferred to first-day deaths and contributed to the recent divergence of these two rates.

Stillbirths by Sex

Until recent years the male stillbirth rate has been consistently, but not greatly, in excess of the female rate (tables 6 and 7). In 1930 the sex ratio was 118 but it has gradually declined until in 1963 it was 105.

In the absence of information regarding the causes of stillbirth before 1960, it is only possible to surmise the trends that have reduced male stillbirths more than female. In 1961 the rates for males and females were about equal. The well-known high proportion of female stillbirths due to congenital malformation of the central nervous system is confirmed by the sex ratio of 48 for that cause group. Congenital malformation of the central nervous system is now the predominant cause of stillbirth, and there seems little reason to suppose that the stillbirth rate from this cause has altered much in recent years. On the other hand, stillbirths ascribed to birth injuries and difficulties in labor with a sex ratio of 125 is presumably linked with the higher average birth weight of males. Stillbirths from these causes probably have been reduced most by the improvement in prenatal and obstetric care.

CAUSES OF DEATH

The trends of mortality from 1950 onward are different from those of earlier years. Since the main tabulations of causes of death are presented only for the later period it will be convenient to consider causes of death before and after 1950 separately, discussing the later period in more detail.

Causes of Infant Death

1936 through 1949.—Prior to 1950 the principal decline in infant mortality was in deaths from infective conditions, which affected mainly the postneonatal period. After temporary halts or rises during the war years mortality from these conditions declined rapidly with the advent of antibiotic therapy (table B). Although for the whole of infancy, mortality from bronchitis and pneumonia was nearly halved, this was not so for pneumonia of the newborn. The steadiness of the rate for pneumonia of the newborn reflects the different etiology of deaths during the neonatal age period, and the more accurate certification of deaths that might previously have been ascribed to premature birth (Code 159 in the Fifth Revision of the International Statistical Classification). In 1949 about one-third of the deaths from pneumonia of the newborn were certified as associated with premature birth.

For conditions stemming from prenatal or intranatal influences that affect mainly the neonatal period, mortality in the aggregate declined considerably, though not so markedly as mortality stemming from postnatal influences (table C). The most striking feature is the halving of the death rate ascribed to premature birth, but undoubtedly this was partly the result of improved certification. The steadiness of the rate for birth injuries and the rise in the rate for asphyxia reflect increasing interest in neonatal pathology and increasing use of autopsies, resulting in "the tendency to prefer proved autopsy findings as the underlying cause to the less definite but etiologically more meaningful term such as immaturity."[2] There were also marked falls in ill-defined conditions such as convulsions or congenital debility which reflect the same tendency. The rise in the rate for hemolytic disease, however, is more likely to have been due to improved clinical rather than postmortem diagnosis.

Although the fall in death rate ascribed to premature birth was partly the result of transference to other rubrics, there was nevertheless a fall of nearly one-third in the combined group of premature birth, birth injuries, asphyxia, and hemolytic disease. Since the latter three are very frequently associated with premature birth, there was clearly a considerable reduction in deaths ascribed to or associated with premature birth. There is no evidence to relate this fall in mortality to a decline in the incidence of low birth weight babies. Data based on all births in England, Scotland, and Wales in one week in 1946

Table B. Infant and neonatal mortality rates from certain infective diseases: England and Wales, selected years, 1936-49

Cause of death[1]	1949	1948	1943-45	1936-39
Infant mortality	Rate per 1,000 live births			
Whooping cough	0.5	0.6	0.8	1.2
Measles	0.1	0.1	0.3	0.5
Tuberculous diseases	0.2	0.3	0.5	0.6
Bronchitis and pneumonia	5.8	6.3	9.3	10.5
Enteritis and diarrhea	2.6	2.9	5.0	5.1
Neonatal mortality				
Pneumonia of newborn	0.9	0.9	1.2	0.9
Enteritis and diarrhea	0.2	0.3	0.6	0.5

[1] Causes of death classified according to the Fifth Revision of the International List of Causes of Death, 1938.

indicate that 7 percent of live births and 7.6 percent of all births were premature by the birth weight standard of 2,500 grams or less.[3] Using the same standard, the Ministry of Health reported that the proportion of premature live births has remained constant since 1953 at just under 7 percent, and for all premature births at just under 8 percent. Reference has already been made to the development of special services for the care of premature infants. The decreasing mortality rates associated with prematurity reflect increasing skills in this field and increasing special facilities and specially trained personnel.

Deaths ascribed to congenital malformations affect both the neonatal and postneonatal periods. Roughly two-thirds of the deaths attributed to congenital malformations occur in the first month of life. The trend for total infant mortality due to congenital malformations prior to 1950 is as follows:

	Rate per 1,000 live births
1949	4.6
1948	4.4
1947	4.9
1946	5.4
1943-45	5.7
1936-39	6.2

The variability in estimates of the incidence of congenital malformations makes it impossible to relate the decline in mortality to a decline in incidence with any certainty. The reduction of deaths during infancy was probably influenced by general improvement in pediatric care including antibiotic therapy, especially as the greater part of the fall was after 1945. There is, however, some evidence that this was not the whole cause:

	Infant mortality per 1,000 live births	
	1947-49	*1937-39*
Congenital heart disease	1.6	2.0
Monstrosity	0.1	0.2
Hydrocephalus	0.2	0.3
Spina bifida	1.1	1.8

While antibiotic or other therapy might well save, or postpone beyond infancy, some of the deaths of infants enfeebled by congenital heart disease, this can hardly be envisaged as causing a similar fall in monstrosity and hydrocephalus and an even greater fall in spina bifida. It is not known whether there was any change in the stillbirth

Table C. Infant mortality rates for selected prenatal and intranatal causes: England and Wales, selected years, 1936-49

Cause of death[1]	1949	1948	1943-45	1936-39
	Rate per 1,000 live births			
Total	14.2	14.5	17.3	20.8
Premature birth	7.6	8.4	11.9	15.5
Birth injuries	2.6	2.6	2.5	2.7
Postnatal asphyxia and atelectasis	3.3	2.8	2.2	2.1
Hemolytic disease	0.7	0.7	0.7	0.5

[1]Causes of death classified according to the Fifth Revision of the International List of Causes of Death, 1938.

rates from these causes at that time since national figures for causes of stillbirth are not available. But, in Birmingham a significant fall was observed in perinatal death due to anencephalus from 2.6 per 1,000 total births in 1940-44 to 1.8 in 1945-49 and for spina bifida from 2.4 to 1.9. [4] Perinatal loss virtually represents the incidence from anencephalus since scarcely any infant with this condition survives birth or early infancy, but whether this local observation represents the national trend can only be surmised. There may also have been some slight decline in the incidence of congenital heart disease arising from the control of rubella in pregnancy.

The gains from advancing skills in neonatal surgery for congenital malformations, though often individually dramatic, were statistically slight in comparison with the great numbers not yet amenable to surgery in infancy. The most notable gain was a sudden drop in the mortality from pyloric stenosis, from 0.4 in 1947 to 0.2 in 1948 and a continuous fall thereafter, which probably reflects concurrent antibiotic therapy and improving techniques in anesthesia.

In summary, of the trends in causes of death from about 1936 through 1949, the infant mortality rate declined 45 percent mainly due to declines of 49 percent in deaths from infective conditions, 33 percent in the group of deaths ascribed to premature birth, birth injuries, and asphyxia, and 26 percent in deaths due to congenital malformations.

1950 through 1963.—Mortality rates from 1950-63 for the main causes of infant death (table 8), and of neonatal and postneonatal deaths (tables 9 and 10) are shown separately. From 1950 onward the terminology of the Sixth Revision of the International Statistical Classification (1948) was brought into use in Great Britian. Among other things, the rubrics "immaturity" (ICD 774 and 776) replaced the previous rubric "premature birth."

In the 1950's and early 1960's infant mortality from infective conditions continued to decline, and by 1963, mortality from specific infections was numerically trivial. Mortality was almost nonexistent in the neonatal period and only meningitis presented appreciable numbers during the postneonatal period. Mortality from respiratory disease, chiefly pneumonia and bronchitis, continued to decline steadily until 1957. Since then there has been no consistent improvement. Mortality from gastroenteritis also fell steadily until 1959. Since then the rate has risen slightly, but the rate in 1963 was still less than one-third of the 1950 figure.

The neonatal mortality rate for immaturity has continuously fallen while those for birth injuries and asphyxia have remained fairly steady. A new feature since 1950 is the absence of any improvement in mortality for the first day of life, due to the unchanging combined mortality from immaturity, birth injuries, and asphyxia. In 1959-61 first-day mortality from this group contributed over one-quarter of all infant mortality.

For hemolytic disease, the rise seen before 1950 was no longer apparent and the rate has fallen fairly steadily since 1951. The fall reflects the advances in recent years in the techniques of treatment and of prenatal diagnosis. The establishment of the National Blood Transfusion Service with regional laboratories during the war provided facilities for the diagnosis of isoimmunization as well as supplies of suitable blood for transfusion of infants with hemolytic disease. Rh testing of blood during pregnancy is now accepted, but is not invariably practiced. Nor are the arrangements for prenatal, natal, and postnatal care of affected babies fully coordinated in all areas. Improvement on these two points could certainly lead to a lower death rate from hemolytic disease, even without further research and new techniques.

The groups of conditions under lack of care and accident (chiefly accidental mechanical suffocation) have also declined. Accidental mechanical suffocation is increasingly recognized as more often due to underlying disease rather than to accident.

The rate for the whole group of congenital malformations has, in contrast with the previous decade, shown little change since 1951, rising slightly from 4.4 per 1,000 live births in 1950-52 to 4.5 in 1959-61.

From this brief review it is clear that the major or resistant problems of infant mortality in recent years are: (1) immaturity and the conditions that are associated with the stress of birth and with immaturity, especially in first-day mortality, (2) pneumonia, (3) gastroenteritis, and (4) congenital malformations. Consequently, these four groups will be considered in more detail.

Immaturity and Low Birth Weight

Deaths ascribed to immaturity, asphyxia, and birth injuries dominate early neonatal mortality. Although the combined early neonatal rate for these three conditions declined from 10.7 per 1,000 live births in 1950-52 to 9.3 in 1959-61 and to 8.6 in 1962, they still account for about 70 percent of deaths in the first week of life. In first-day mortality these conditions account for about 75 percent of the deaths, and the combined rate for these causes remained unaltered at 5.8 in 1950-52 and in 1959-61, with only a slight fall to 5.4 in 1962.

Roughly half the deaths ascribed to birth injuries and two-thirds of those ascribed to asphyxia are certified as associated with immaturity. For some of the less frequent causes of early neonatal death the association with immaturity is even higher. For example, three-quarters of those assigned to ill-defined diseases of early infancy and nearly all the small group attributed to maternal toxemia (188 deaths in 1962) were associated with immaturity.

The influence of immaturity on first-week deaths is seen more precisely in table D which shows the first-week death rates by sex for 1950 and 1960. Early neonatal mortality influenced by immaturity has declined, but its contribution to the total early neonatal mortality has remained proportionately unchanged. Even the figures in this table take no account of immaturity associated with conditions not included in diseases of early infancy (e.g., congenital malformations) in which immaturity, if mentioned, is not coded though it may or may not have influenced mortality.

The fall in the rates of deaths from "immaturity alone or primary" and the rise in those where immaturity is associated with diseases of early infancy indicate a continuation of the aforementioned trend of giving a more definite pathological finding as the primary cause of death and of recording immaturity on the death certificate as a contributory condition. The Registrar General noted in 1958 that in 56 percent of infant deaths from birth injuries and asphyxia, the cause of death had been certified after postmortem examination.[5]

Consideration of mortality rates among infants of low birth weight confirms the findings related to immaturity in certified causes of death. Tables 11 and 12 are based on figures derived from notifications of premature births (i.e., births of 2,500 grams or less) and published in successive Annual Reports of the Ministry of Health of England and Wales.

First-day mortality of infants weighing 2,500 grams or less has shown little consistent change from 1953 through 1963, which correspond with the halt in the decline of first-day mortality among registered causes of death in which immaturity is the dominant factor. It may be estimated that with an average of over 50,000 low weight live births annually and a first-day mortality rate of about 83 per 1,000 live births, these

low birth weight babies contribute over 4,000 deaths to the total of approximately 6,000 registered deaths on the first day of life.

Although the *proportion* of low birth weight babies among live births remained unchanged at a little under 7 percent from 1953 to 1963, there was a considerable increase in the *number* of such births primarily due to the rise in the total birth rate since 1955. Table 12 shows that the distribution of low birth weight babies by birth weight has also remained unchanged. Recently the number of babies in the weight group 1,000 grams or less has been recorded; these accounted for 4 percent of the total live births of 2,500 grams or less in 1963, 1964, and 1965. This same proportion was noted in the admittedly incomplete records in 1951 and 1952 and was recorded by Crosse in Birmingham in 1956-58.[6]

Although first-day mortality of low birth weight babies remained unaltered, total neonatal mortality in this group fell steadily by 17 percent from 1953 to 1963. The decline was roughly the same in all weight groups, except the lowest (1,500 grams or less) which fell by only 9 percent.

Since total neonatal mortality is still declining, the full potential of increased obstetric and pediatric skills in the care of these low weight babies has probably not yet been reached. This was evident when the Ministry of Health surveyed the hospital and domiciliary facilities for the care of premature infants in 1957. For instance, of infants weighing less than 1,500 grams who were treated in hospital, only 45 percent were admitted to premature baby units which were staffed by midwives and nurses with special training and experience engaged full time in care of prematures. As a result the whole problem of prematurity was reviewed afresh by the Minister's Advisory Medical and Maternity Committee, and their advice on comprehensive schemes for the care of premature infants and the prevention of prematurity was circulated to hospitals and local authorities.

The need for good prenatal care, and for immediate admission to hospital of all women going into labor before the 37th week was advocated, even if prior arrangements had been made for confinement at home. Special attention was

Table D. Mortality in the first week of life due to or associated with immaturity, by sex: England and Wales, 1950 and 1960

Cause of death[1]	1960		1950	
	Male	Female	Male	Female
	Rate per 1,000 live births			
All causes	15.4	11.2	17.5	12.8
Immaturity, or with mention of immaturity--774,776,760-773[2]	8.9	6.4	10.0	7.6
Immaturity alone or primary--774,776	4.2	3.2	5.9	4.8
Immaturity associated with diseases of early infancy--760-773[2]	4.7	3.2	4.1	2.8
	Percent of total			
Immaturity, or with mention of immaturity-774,776,760-773[2]	58	57	57	59

[1]Causes of death classified according to the Sixth Revision of the International Lists, 1948.

[2]For each ICD code number, includes only that portion ending in .5.

also drawn to the need for nondepressant maternal analgesia and anesthesia in premature labor, to the advantage of prophylactic episiotomy, and also for a prepared plan for the management of asphyxia after birth. Partly as a result of the recommendations of this Comittee, a comprehensive premature baby care program has been introduced in many areas to raise the general standard of care. Perhaps the greatest improvements have been in specialized medical supervision; in higher standards of nursery accommodation and equipment; in improved number, status, and experience of nursing staff engaged in premature baby care; in more satisfactory arrangements for resuscitation of infants in hospital; and in better transport provision.

Most of the larger health authorities in Britain run a home-nursing service for premature babies, but immediate hospital admission is usually arranged when the birth weight is under 2,000 grams (4 lb., 6 oz.). Immediate hospital admission is also arranged in the presence of any complication such as cyanotic attacks, convulsions, jaundice, or infection. The provision of special transport facilities has undoubtedly reduced the mortality among premature infants transported from home to hospital immediately after birth or later as emergency cases. These infants are usually transported in a heated ambulance provided by the Health Authority with provision for oxygen administration and also for care en route by a nurse proficient in premature baby care.

Aftercare of low birth weight infants has also improved. Before discharge, a visit is usually made through the social services to ensure that home circumstances are satisfactory. Where possible, the mother spends the final few days in the premature unit either on a residential or daily visiting basis. Routine aftercare usually includes regular observation at infant welfare clinics or by health visitors. Supplements of iron and vitamins A, C, and D are given widely. Followup of low birth weight or other high-risk babies is carried out either in hospital clinics run by consultant pediatricians, or in some cases by the Local Health Authority Medical Officer or a general practitioner.

Thus, better administration, better deployment of clinical skills, and further research may be expected to maintain the fall in neonatal mortality of premature infants. The decline may extend to all infants because special facilities primarily designed for the care of prematures are now widely used for other infants at special risk.

The lack of improvement in first-day mortality in all low birth weight groups, and in total neonatal mortality in the lowest weight group, suggests a "hard core" that has so far been little affected either by intranatal obstetric care or by immediate postnatal pediatric care. This group includes infants with severe congenital malformations, but necropsy reveals the most frequent causes of death as failure to maintain respiration because of lesions grouped under such terms as "pulmonary syndrome of the newborn" or "abnormal pulmonary ventilation." Whatever the nomenclature, or whatever the precise conditions included in these terms, all investigators agree that hyaline membrane or intraventricular hemorrhage are characteristic findings in necropsies on low birth weight infants. The British Perinatal Mortality Survey identified a group of neonatal deaths associated with premature delivery and often also with clinical respiratory distress which they entitled "respiratory distress syndrome." (See appendix I for definition.) Among low birth weight babies, 44 percent of the early neonatal deaths fell into this category. This incidence was eight times greater than among babies weighing more than 2,500 grams. In this series, the other frequent primary necropsy findings in low birth weight infants were congenital malformations (15 percent), intrapartum anoxia and/or cerebral birth trauma (12 percent), pulmonary infection (10 percent), and massive pulmonary hemorrhage (7 percent). In cases that fell into "respiratory distress syndrome" or intrapartum anoxia and/or cerebral birth trauma, the majority of first-week deaths occurred during the first 24 hours of life.

Since first-day mortality is very largely a question of mortality of immature or low birth weight babies, the solution of this resistant problem apparently lies in (1) the prevention of premature delivery especially at very low gestations, and (2) the prevention or successful treatment of pathological conditions noted in early neonatal death in premature infants.

Some years ago it was thought that the former proposition offered the better hope of success. Yet, although the factors that predispose to prematurity have been recognized and have formed the basis of teaching for many years, the incidence of premature birth (both live birth and stillbirth) has remained unaffected, at least for the past 20 years. Twenty years is, however, a short time for the observation of a condition in which biologic factors such as maternal age, parity, physique, sex ratio, birth spacing, and multiple pregnancy all play a part. Also to be considered are the complex effect of socioeconomic circumstances and the obscure etiology of many congenital malformations. Moreover, there is little information about the bearing of these factors on premature termination of pregnancy before the 28th week. A major breakthrough still awaits success in research on the causation and control of preeclamptic toxemia. Yet even on present knowledge most inquiries on maternal and perinatal mortality still yield evidence of prenatal and obstetric care that has not yet reached the high standard required to minimize the dangers of toxemia.

Although the problem of preventing prematurity remains unsolved, advances in the knowledge of intranatal and neonatal physiology and pathology now seem to hold out hope of reducing the intractable perinatal mortality of premature infants. There is as yet little prospect of any reduction in the deaths due to congenital malformations, but there is perhaps a reasonable prospect that anoxic states and respiratory syndromes may yield, at least to some extent, to the obstetric and pediatric techniques coming into use in the last few years for the prevention of anoxia and the resuscitation of the newborn.

First-day mortality of low birth weight babies has fallen slightly in each of the last 3 years and reached its lowest level in 1963 (table 11). Among registered causes of death on the first day, the group ascribed to immaturity, birth injury, and asphyxia reached its lowest level in 1962 (the latest rate available). The changes are too slight to warrant any firm conclusion as yet, but there is at least a possibility that they may reflect the most recent advances in the care of the premature infant.

Pneumonia

Infant mortality ascribed to respiratory diseases—influenza, pneumonia, bronchitis, and "other" respiratory diseases—fell from 5.7 per 1,000 live births in 1950-52 to 3.6 in 1959-61, but all the improvement occurred prior to 1958. Since then there has been no consistent change in the rate.

Pneumonia is predominant in the group of respiratory diseases, contributing 80 percent to the postneonatal deaths and over 90 percent to neonatal deaths. The cessation of improvement after 1957 occurred in both neonatal and postneonatal deaths. Among the latter the greater part of the mortality occurs under 6 months. The first rise in the postneonatal rate for many years followed an epidemic of "Asian flu" which affected this country for the first time in the winter of 1957-58, but there have been no widespread influenza epidemics since then and the rise in 1958 may have been coincidental.

Postneonatal pneumonia is much more common in the low socioeconomic groups, and a lessening may be expected with better socioeconomic circumstances and increasing prophylactic use of welfare facilities. There is no reason to suppose that postneonatal deaths have increased from pneumonia following specific fevers such as pertussis or measles. Likewise, no evidence exists that staphylococcal or other bacterial pneumonias have shown an increased mortality. Many of those dying with previously resistant organisms are now responsive to the newer penicillins.

The rapid advances in virology in the past 10 years have thrown new light on the etiology of respiratory disease. Viral infection is now being increasingly demonstrated as a cause of respiratory disease, especially the respiratory syncytial virus in bronchiolitis in infancy. Localized winter epidemics ascribed to this infection have been reported in recent years and a low antibody response observed in young children. To a lesser extent other myxoviruses and influenza A and B and adenoviruses have also been incriminated. The relationship of viral infections with mortality is not yet entirely clear.

To sum up, there seems a strong probability that whereas antibiotic therapy has controlled the mortality of bacterial pneumonic infection, there is still a residual mortality from previously unrecognized viral infections which are unresponsive to antibiotics and that this is preventing, for the present, further improvement in the mortality from respiratory diseases in infancy.

Some small part of the mortality ascribed to pneumonia is also probably a transference from accidental mechanical suffocation. Deaths ascribed to this cause rose to their highest level in 1947. Since then they have been steadily declining. Many investigations in this country, in the United States, and elsewhere have led to the recognition that fulminating illness is frequently the cause of sudden cot (crib) death, rather than accidental choking or smothering, and it is likely that an increasing number are now ascribed to acute respiratory conditions. In this country viral infection in lungs or elsewhere has not so far been demonstrated in cot death and the etiology is still uncertain in many of these deaths.

Gastroenteritis

As with pneumonia, mortality attributed to gastroenteritis declined steadily until 1958. Since then the rate has risen, especially in the postneonatal period, though it still is well below the level at the beginning of the decade. The greatest part of postneonatal mortality from this cause occurs before the 6th month of life.

Gastroenteritis, as represented in certified causes of death, is a somewhat heterogeneous group which may include dietetic diseases, gastrointestinal infection, or the terminal event of other infections. This and the comparatively small numbers involved (55 neonatal deaths and 395 postneonatal deaths in 1962) make it difficult to interpret the recent trend.

Because of the rise in postneonatal mortality in the last few years, the Ministry of Health in 1964 initiated a preliminary inquiry, requesting an investigation and report on each postneonatal death, from whatever cause, during that year in two cities and one county area. When the results of the inquiry have been analyzed they will no doubt throw more light on the subject of postneonatal death including gastroenteritis and point the way for more widespread investigation if necessary.

Congenital Malformation

Mortality due to congenital malformation has not maintained the decline noted prior to 1950. The total rate was 4.4 per 1,000 live births in 1950-52, 4.5 in 1959-61, and 4.6 in 1962. It may be noted that the rate was 4.4 in 1901-5 and at that time congenital malformation contributed about 3 percent of all infant mortality. Now, with the rate hardly altered, they contribute over 20 percent.

The steadiness of the rate for congenital malformation since 1950 is apparent in all age groups in the first year. There does not appear to have been any noticeable saving of life in the younger age groups leading to postponed deaths in the older groups.

The group of deaths under the heading "other congenital malformations" shows a slightly rising trend, which is mainly due to an increase in deaths from "monstrosity." The deaths included in the category "other malformations" in 1962 are given in table E.

From registered causes of death, it is not possible to estimate the distribution of the various types of fatal malformations, because of the multiplicity of malformations in many cases and because of the frequent lack of postmortem examinations.

All investigators agree that malformations of the central nervous system are the most frequent and this group presents some features of interest. Table 13 shows recent infant death and stillbirth rates due to major malformations of the central nervous system, together with the perinatal loss in 1962 by sex. The perinatal loss from anencephalus and monstrosity in 1961 and 1962 may be compared with the figure for anencephalus of 2.3 per 1,000 total births in Birmingham in 1940-47,[7] and the same rate (2.3) in the Perinatal Mortality Survey in England, Scotland, and Wales in March 1958.[1] Until information on the causes of stillbirth is available for a longer period it

Table E. Infant deaths due to selected congenital malformations: England and Wales, 1962

Congenital malformation[1]	Number
Monstrosity----------750	204
Central nervous system (other than spina bifida and hydrocephalus)----------753.1	76
Circulatory system (other than heart)----------754.6,754.7	206
Cleft palate and harelip------755	9
Digestive system:	
Pyloric stenosis----------756.0	33
Imperforate anus----------756.1	28
Other----------756.2	349
Bones and joints----------758	48
Respiratory system----------759.0	66
Skin----------759.1	8
Muscle----------759.2	23
Other and unspecified-------759.3	220

[1] Causes of death classified according to the Seventh Revision of the International Lists, 1955.

may be premature to assume that the downward trend of infant deaths for spina bifida and the upward trend for monstrosity are indicative of a changing trend in the total perinatal loss.

Reference has already been made to the low sex ratio in malformations of the central nervous system which is strongly marked for anencephalus and spina bifida but much less so for hydrocephalus (table 13).

A seasonal variation for anencephalus was found in Birmingham in 1940-47, with higher rates during October to March,[8] but the national records of causes of death showed no seasonal variation for monstrosity in 1955-59. A winter rise that occurs in some other congenital malformations seems explainable as due to intercurrent infection in handicapped infants.

Mortality from malformations of the central nervous system shows considerable geographic variation, even within England and Wales, with a descending gradient from northwest to southeast. For 1950-58 the average rate of female deaths from malformations of the central nervous system ranged from 2.4 in Wales and the northwest of England to 1.3 in the southeastern part of the country, and the male rate ranged similarly from 1.7 to 1.0. There is a similar gradient for other malformations (and, in fact, for most causes of infant mortality), but it is much more strongly marked for malformations of the central nervous system. The same steep gradient is also present for stillbirths due to central nervous system malformations, the rates for Wales and the northwest being about double those in the southeast. This geographical distribution corresponds with the observation that anencephalus demonstrates "a decreasing gradient of frequency from Northern Ireland and Scotland to southern England."[9] The reason for the distribution remains unexplained as yet, but it may be related to ethnic differences in the population, or climatic or geological conditions since all the mountainous terrain lies in Wales and the northwest of England.

Because the etiology of all but a small proportion of congenital malformations is still obscure, the prospect of effecting a reduction in their incidence remains slight as yet. Indeed, in the thalidomide tragedy of 1960-62 there was clearly a temporarily increased incidence of malformations, though apparently with no great effect on mortality. The hazards of new and possibly teratogenic drugs or other chemical agents, the uncertainties of radiation risks, and the possibility of viral risks other than rubella have made it imperative to supplement existing knowledge with national epidemiological information. With this end in view, the Ministry of Health introduced in 1964 voluntary notification, by doctors and midwives, of congenital malformations observed at birth for the compilation of a national statistical register at the General Register Office. In addition, Medical Officers of Health follow up the notifications and compile local nominal registers, kept up to date as additional information becomes available and so providing a basis for the continued supervision of each child, as well as a local statistical record. Several large towns have maintained local registers of this type for some years. The need for more information on congenital malformations also influenced the decision in 1960 to include a statement on cause in the registration of stillbirths. Nationwide infor-

mation on incidence, supplementing the registration of deaths and stillbirths, has become an essential safeguard against the appearance of unforeseen factors in the etiology of congenital malformations.

Causes of Stillbirth and Perinatal Death

Registered Causes, 1960-62

Registration of the cause of stillbirth was introduced in this country in October 1960. In the published national figures, causes are classified according to the International Classification of Diseases (ICD). With such recent introduction of the registration of cause, and having regard for the well-known difficulties of defining and classifying the causes of stillbirth, the information so far available is of limited value.

Maternal conditions, principally toxemia and difficulties in labor, account for about 30 percent of stillbirths and placental and cord conditions for rather under 30 percent, but there is obviously considerable imprecision in the distinction between these two groups. Fetal conditions account for about 45 percent of stillbirths, with congenital malformations as the highest single cause, contributing roughly 20 percent of all stillbirths. Nearly 88 percent of the malformations affect the central nervous system.

British Perinatal Mortality Survey, 1958

Pathological information on a national basis was available for the vast majority of stillbirths and early and late neonatal deaths in March 1958, from the British Perinatal Mortality Survey.[1] The pathological data are based on precoded reports which covered 96 percent of the stillbirths and neonatal deaths in hospitals, 91 percent of those in general practitioner maternity units, and 85 percent of the deaths at home, all of which occurred in March 1958. This part of the inquiry was carried out at specially designated pathology centers and included necropsy by a standardized technique and full histological examination. A "primary necropsy finding" was agreed upon for each case, i.e., "the morbid anatomical finding considered to be least compatible with separate existence." The survey thus presents, for the first time, the national distribution of primary necropsy findings (table 14). Among stillbirths, the major necropsy findings were:

	Percent
Congenital malformations	17.5
Antepartum anoxia	17.4
Antepartum death with no major lesion	17.0
Intrapartum anoxia	30.8
Intrapartum anoxia with cerebral birth trauma	7.8
Cerebral birth trauma	1.7
Isoimmunization	4.4

First-week deaths were associated with a high incidence of findings related to premature delivery and which were considered typical of "respiratory distress syndrome" as defined in appendix I. These consisted of hyaline membrane (15.0 percent), intraventricular hemorrhage (6.4 percent), and neonatal death with no histological lesion (8.7 percent), together making up a total of 30.1 percent. Lethal congenital malformations were found in 21.6 percent, delayed effects of intrapartum anoxia and/or cerebral birth trauma in 19.6 percent, pulmonary infection in 13.3 percent, and massive pulmonary hemorrhage in 5.9 percent. This simple anatomic classification is based only on the major necropsy findings considered responsible for death. It forms a useful basis for examining the clinical associations of six major groups of pathological causes of perinatal death.

Congenital malformation.—In the British Perinatal Mortality Survey, lethal congenital malformations caused 5.8 perinatal deaths per 1,000 total single births and comprised 19 percent of perinatal deaths (table 14). Perhaps the value of such a survey of congenital anomalies is mainly to show the distribution by bodily systems involved. In 415 perinatal deaths in March 1958 due to malformations confirmed by necropsy, the following distribution was found:

	Percent
Central nervous system	67
Alimentary tract	24
Urogenital system	24
Skeletal system	21
Cardiovascular system	20
Other systems	20

More than half the cases showed involvement of more than one system. Such a breakdown allows an estimate of the proportion in which surgery may be feasible. Nearly two-thirds of the babies dying with malformations of the cardiovascular system also had malformations of other systems and the majority of the cardiac abnormalities were so gross as to make corrective surgery impracticable. "Curative" neonatal cardiac surgery is limited to straightforward cardiovascular lesions such as patent ductus arteriosus or coarctation of the aorta, but "salvage" surgery is now becoming increasingly possible, in particular for lesions such as ventricular septal defect or transposition of the great vessels to gain time for more radical procedures later. Any baby developing cardiac failure from congenital heart disease in the first month of life had an extremely poor prognosis.

Neonatal surgery has made considerable strides in attempted correction of other malformations and up to 20 percent of severe anomalies recognized in the first week of life must now be considered potentially operable. Important among this group are those malformations connected with the alimentary tract, principally esophageal atresia (1 in 2,500 births in the British Survey) and diaphragmatic hernia (1 in 2,000), as well as rectal malformations, exomphalos, duodenal or other bowel obstructions, volvulus, meconium ileus, and Hirschsprung's disease. Other operable anomalies include urogenital malformations such as bladder-neck obstructions, or respiratory tract malformations such as choanal atresia, congenital lung cyst, or lobar emphysema. Currently meningomyelocele (incidence of 3 per 1,000) is "treated" by early decapping of the spinal sac, followed later by the insertion of a Holter or similar valve to avoid the almost inevitable hydrocephalus.

Provision is needed for major neonatal surgery for at least one in every 500 live births and results are proportionate to the skill of the operator and the specialized facilities available.[10] Early diagnosis is paramount and depends on alertness on the part of family doctors, obstetricians, pediatricians, and midwives. Transfer of infants over considerable distances seems to do little harm provided that the infant can be protected against heat loss and that an experienced nurse also travels in the ambulance. Highly trained medical and nursing personnel and staff can best be utilized in a regional surgical unit, such as in Liverpool, where since 1953 a special unit has served a region of approximately 3 million population.[11] This unit is situated at a children's teaching hospital in a university center, thus ensuring the availability of specialist surgeons, pediatricians, pediatric anesthetists, pathologists, biochemists, radiologists, and various research workers needed for the advancement of neonatal surgery.[12,13]

Reviewing the development of pediatric surgery in relation to congenital malformations, the Chief Medical Officer of the Ministry of Health in his Annual Report for 1962 noted that "the success of the small number of specialized pediatric surgical departments which now exist cannot be disputed."[14] Until research throws more light on the causation of congenital malformations, surgery with the essential prerequisite of early and expert diagnosis remains the most fruitful but limited line of progress. Perhaps the other hope of reduction in mortality lies in more research on genetic and teratogenic influences. Chromosomal aberrations probably account for less than 10 percent of fatal perinatal congenital anomalies. Though teratogenic influences such as intrauterine rubella probably cause less than a further 5 percent, there is a greater chance of their control. The use of gamma globulin prophylaxis early after exposure in pregnancy may reduce, but cannot eliminate, the latter danger. Recently several promising rubella vaccines have been developed and active immunization in the near future is a possibility.

Hemolytic disease of newborn.—In the British Perinatal Mortality Survey, stillbirth or early neonatal death from isoimmunization occurred in 1.3 per 1,000 total births, representing between 3 and 4 percent of the total. Nevertheless, the problem is quite an important one. Walker[15] estimates that the overall incidence of babies in England affected by isoimmunization, fatal and nonfatal, is at least 6 per 1,000 births. Infant mortality in England and Wales attributed to hemolytic disease of the newborn fell from 0.7 deaths per 1,000 live births in 1950 to 0.5 in 1959-61. Walker and Mollison[16] calculated that this figure should be no higher than 0.2 when ex-

change transfusion is used correctly. This goal could perhaps be achieved by better prenatal prediction leading to measures such as intrauterine transfusion or selective induction of labor, and, for severely affected liveborn infants, by extended or repeated exchange transfusion.

New efforts at salvage must also be concentrated on the prevention of stillbirths, particularly in first affected pregnancies. Twice as many babies in the British Survey died from isoimmunization in the late fetal period as in the neonatal period. The overall risk of stillbirth among sensitized Rh negative women in Britain is about 15 percent. Walker and Murray[17] have shown that this risk varies according to the severity of the disease in any preceding siblings. With no previous affected infant the risk is 8 percent, rising to 20 percent where exchange transfusion has been necessary for a previous affected infant, and to 50 percent if the preceding infant has been severely affected. If previous hydrops occurred, the risk was 70 percent, rising to 80 percent if more than one similarly affected infant had been born to that mother. This statistical prediction is used to guide management and to ensure supervision of these pregnancies.

The first step in active management is clearly to determine the Rh genotype. Yet in the control week of the British Survey the Rh group was not determined in 15.7 percent of pregnant women in Scotland, 8.9 percent in Wales, and 3.9 percent in England. The proportion was nearly double for women booked for delivery outside obstetric hospitals. A high-risk group which stood out in particular was grandes multiparae (parity 4 and over); Rh negative grandes multiparae had a 75 percent higher total risk of losing their baby than Rh positive grandes multiparae, and one in three of all perinatal deaths of infants born to these women was due to isoimmunization. Yet one in nine of grandes multiparae was cared for without knowledge of her Rh genotype.

Regular antenatal serological examination for antibodies is essential in order to forecast accurately the presence and severity of intrauterine hemolysis and to plan management accordingly. Spectrophotometric examination of amniotic fluid is said to give up to 85-95 percent accuracy of prediction of a severely affected infant and to be more accurate than antibody tests in confirming the presence or absence of an affected baby in utero. Taken in conjunction with the past clinical history and the results of antibody tests, amniocentesis provides a sensitive indication as to when induction or other obstetric procedure should be carried out. Most British obstetricians are loath to induce labor before the 37th week of gestation because of technical difficulties and also because of the added danger of respiratory distress syndrome in the prematurely delivered infant. One method of tiding over severely affected babies until they are mature enough for induction is that of fetal intraperitoneal blood transfusion.[18] This is considered when amniocentesis and antibody tests in the 25th to 34th week of pregnancy have indicated severe hemolytic disease.

Among liveborn affected babies, as defined by a positive Direct Coombs Test on cord blood, only about 60 percent required exchange transfusion. In the United Kingdom as a whole, the indications for exchange transfusion are not standardized. If the criteria for immediate exchange transfusion are not met, the baby is observed carefully for abnormal signs and serial bilirubin estimation is carried out, with exchange transfusion if there is a rapid or progressive rise in bilirubin, or if the clinical condition deteriorates. Few deaths are now reported during exchange transfusion with modern techniques. Reexchange transfusion is usually performed if the bilirubin subsequently rises above 20 milligrams percent. These measures have made kernicterus very rare, and the majority of neonatal deaths from isoimmunization are in babies born so severely affected that exchange transfusion cannot be effective in time.

Antepartum stillbirth.—Antepartum stillbirth, which included stillbirth occurring after the 28th week of pregnancy but before the onset of labor which was not due to congenital malformations or isoimmunization, comprised 22.1 percent of all perinatal deaths in the British Survey (table 14). The national frequency was 6.8 perinatal deaths per 1,000 total single births.

Hypertension, preeclampsia, antepartum hemorrhage, low social class, and prolonged pregnancy were all significant maternal associations. There is no doubt that intensive prenatal care and the use of induction in selected cases

could reduce perinatal mortality in this category. In particular, the too frequent instances of inadequate prenatal care or poor judgment in the selection of cases for consultant care in hospital clearly indicated a potential for salvage especially in many instances of preeclampsia.

Intrapartum anoxia and/or cerebral birth trauma.—Evidence of asphyxia during labor and/or cerebral birth injury was much the most frequent finding in the British Survey, being responsible for 10.2 fatalities per 1,000 total single births and causing 32.9 percent of all perinatal deaths (table 14). These deaths are perhaps those most susceptible to improvement by better obstetric techniques.

Anatomically these cases fell into three categories: (1) intrapartum anoxia, (2) intrapartum anoxia with cerebral birth trauma, and (3) cerebral birth trauma. These categories are defined in appendix I. Since cerebral trauma is usually inflicted in attempts to deliver an anoxic baby, the maternal associations for all three categories are mainly similar and they can be considered for this purpose as one group.

The following pregnancy and labor factors were shown to be significantly associated with an increased risk of perinatal death from intrapartum anoxia and/or trauma:

(1) families of poor socioeconomic status, for example if the husband was an unskilled laborer

(2) first and fifth or subsequent pregnancies

(3) maternal age over 30 in primaparae and multiparae

(4) previous perinatal death, previous live birth weighing 2,500 grams or less, or an antepartum hemorrhage in a previous pregnancy

(5) maternal hemoglobin less than 60 percent in pregnancy

(6) preeclampsia as defined by a diastolic blood pressure above 100 mm. Hg. at any time in pregnancy (mortality was increased substantially when hypertension was complicated by proteinuria)

(7) antepartum or intrapartum hemorrhage and/or vaginal bleeding before the 28th week of gestation

(8) onset of labor before 37 or after 42 weeks of gestation, especially in the presence of hypertension

(9) first stage of labor longer than 24 hours or second stage longer than 150 minutes

(10) breech presentation or prolapsed cord

(11) baby substantially overweight or underweight for gestational age, especially if delivery occurred after 41 weeks' gestation

(12) baby weighing 2,500 grams or less or more than 4,500 grams, regardless of gestation age

None of the babies whose deaths were due to intrapartum anoxia and/or trauma showed other anatomical abnormalities and 75 percent were of sufficient maturity to escape neonatal hazards associated with early delivery. Much, therefore, can be learned about avoiding these deaths from a careful consideration of the associations during pregnancy and labor listed above. In particular, prolapse or presentation of the cord, antepartum hemorrhage of all types, and breech delivery accounted for nearly two-thirds (61 percent) of the deaths from intrapartum anoxia and/or trauma. The first two offer little chance of improvement. However, the risk from breech delivery, which in the British Survey carried a 10 percent fetal mortality in labor, can be reduced to less than 1 percent in expert hands. Earlier recognition of breech presentations, their correction if possible, and delivery by skilled obstetricians are clearly essential.

Thirty-one percent of mothers losing their babies from intrapartum anoxia and/or trauma had both a raised diastolic blood pressure and prolongation of pregnancy beyond 42 weeks. Both preeclamptic toxemia and prolongation of pregnancy are associated with reduced choriodecidual blood flow[19] and reduced fetal growth.[19,20] Fetal reserves necessary for survival from the inevitable anoxia of *normal* labor are reduced, thus increasing the likelihood of death from anoxia in labor. Very careful prenatal observation including placental function tests is particularly indicated in the presence of moderate or severe hypertension. In such cases, induction of labor is indi-

cated anyway at or before term and early action is essential in the presence of minimal signs of fetal distress.

The remaining 8 percent of mothers losing their babies from causes in this group suffered none of the abnormalities specified above. Death from this condition is therefore a rare event in cases with uncomplicated pregnancy and normal labor.

Within the group intrapartum anoxia and/or trauma, cerebral birth trauma with or without anoxia was much less frequently encountered than uncomplicated intrapartum anoxia. In the Survey, the early neonatal death rate for cerebral birth trauma, with or without anoxia, was 1.2 per 1,000 live births. It is worth noting from official returns that the early neonatal death rate from Injury at birth (ICD 760,761) was 2.3 in 1959-61 and has been at or above this figure for many years. Admittedly the ICD rubric includes all types of birth injuries, but the great majority are classed as intracranial and it would seem that the official rate overestimates the mortality from pathological cerebral trauma. This is probably partly due to certification without postmortem examination, to differing opinions on the interpretation of postmortem findings, and to difficulties and misinterpretations in coding. The terminology of modern neonatal pathology raises difficulties in coding within the present International Classification. The British Survey confirmed, for example, that many cases of intraventricular hemorrhage, a manifestation of extremely premature delivery, are coded as birth injury. A comparison (unpublished) was made among neonatal deaths occurring in March 1958 in England, Scotland, and Wales of registered causes of death with primary necropsy findings as determined in the Survey. This showed that of 316 neonatal deaths which had been classified as Intracranial or spinal injury (ICD 760) less than 40 percent had true cerebral trauma at necropsy; as many as 25 percent of the total were cases of hyaline membrane or other pathological diagnoses known to follow premature delivery.

Cerebral trauma was found less frequently in the British Survey than the official figures might suggest, but the danger of intrapartum anoxia is probably insufficiently appreciated. It was considered that this constituted the group with the greatest potential for salvage and emphasized the need for planned obstetric management as well as careful study of maternal associations and of placental structure and function.

The Survey showed the need for wider use of resuscitative techniques. In as many as 26 percent of first-day deaths the newborn infant died as the result of intrapartum anoxia and/or trauma. Yet in this subgroup intratracheal intubation, aspiration, or intermittent positive pressure oxygen had been given in only 6 percent.[21] Cerebral trauma was usually neither a contributory nor main factor in causing death, and among those dying of asphyxia, inhalation of thick meconium into the air passage was a frequent finding (33 percent). Cesarean section is often carried out for fetal distress, and an intubation rate of 24 percent was found to be necessary after cesarean section in one British obstetric unit, using as criterion for intubation the failure to establish respiration within 1 minute of delivery, or the presence of secondary apnea.[22] In the Survey, the corresponding intubation rate was only 2 percent.

Since 1958, a more positive attitude to resuscitation has been advocated increasingly in the United Kingdom. Barrie[23] advocates a "planned regime" leading up to intratracheal intubation with intermittent positive pressure oxygen and closed cardiac massage where necessary. Clearing of air passages, nasal oxygen, and mild peripheral stimulation are practiced initially but are supplemented by intratracheal intubation at once if the baby remains or becomes apneic, white, or flaccid. Stimulants have been mainly discontinued, apart from pethidine (meperidene)-antagonists, although sublingual nikethamide or vandid (vanillic acid diethylamide) are sometimes given.

Respiratory distress syndrome.—In the British Survey, the group of early neonatal deaths entitled "respiratory distress syndrome" comprised three necropsy categories, in each of which the commonest associations were premature delivery and clinical respiratory distress. The three necropsy categories were (1) atelectasis with hyaline membranes, (2) intraventricular hemorrhage, and (3) deaths without obvious pathological lesions other than atelectasis even on histological examination of lungs. Clearly all babies dying in the first week who were born

preterm (before 37 weeks) or who were of low birth weight did not fall into one or more of the above three categories. Many died from causes not directly associated with prematurity, for example, congenital malformations or isoimmunization. The frequency of early neonatal deaths from "respiratory distress syndrome" in the Survey was 3.3 per 1,000 total single births, which made up 30.1 percent of all early neonatal deaths (table 14).

Management of babies with clinical respiratory distress is still, some years after the Survey, a supportive and largely empirical procedure. Many centers in the United Kingdom practice correction of any accompanying biochemical changes, such as low pH, respiratory and metabolic acidosis, and hypoglycemia. A lessening in incidence of clinical respiratory distress has been reported in recent years.[24] Evaluation is proceeding of newer therapeutic weapons for severe cases, such as buffer agents, artificial ventilation, or use of increased atmospheric tension, but all recognize that prevention of early delivery is the really important measure.

The main association of hyaline membrane disease is known to be premature delivery. In the absence of precise indications, many obstetricians are now wary of inducing labor, and particularly of the use of cesarean section, when the gestation is less than 37 weeks.

Among those deaths in the British Survey where no histological lesion was found were many small babies with primitive lung patterns on the borderline of viability. There is no official lower gestation or birth weight for babies who are not liveborn, nor any stipulations as to the minimum time of survival for inclusion in statistics in England, Scotland, and Wales. Differences in national definitions of viability may alter not only the total perinatal mortality, but also the contributions made to all perinatal deaths from the "respiratory distress syndrome" group. Efforts at salvaging the very immature baby born at around the 28th week of gestation have so far proved singularly disappointing.

Pulmonary infection.—Pulmonary infection was considered to be the direct cause of early neonatal death in 1.5 per 1,000 total single births in the Survey (table 14). Among the early neonatal deaths it was a direct cause in 13.3 percent and a contributory cause of death in another 6.6 percent. Infections other than pneumonia very rarely had a fatal outcome in the first week of life.

The Survey revealed an increased risk of pulmonary infection when the membranes had been ruptured for more than 24 hours, or when there had been obstetric intervention in labor, prolonged labor, or maternal intrapartum pyrexia. Intrapartum administration of nontoxic antibiotics prophylactically for the at-risk baby at birth, especially where there has been any difficulty in establishing respiration, is a measure now widely employed. Cloxacillin and ampicillin in combination are popular in view of wide spectrum and low toxicity. Antibiotics which are potentially toxic to the neonate, such as chloramphenicol, novobiocin, sulfafurazole, or tetracycline are usually avoided. The Survey results showed that systemic antibiotic therapy should also be considered postnatally for any baby who develops signs of local infection, such as conjunctivitis, umbilical inflammation, or pyelitis, in view of the danger of rapid and widespread dissemination of infection.

In the Survey, very small or immature infants often died with pulmonary infection. Efforts have been made to supplement the low level of inherited IgG gamma globulin found in such babies with injections of gamma globulin or to anticipate infection with prophylactic antibiotics.

A more promising group for salvage consists of larger babies dying with pulmonary infection. In the British Survey, 53 percent of first-week deaths from pulmonary infection weighed over 2,500 grams and 56 percent were of 36 or more weeks of gestation, being therefore of favorable birth weight and gestation for survival. Many had already survived fetal distress with meconium aspiration. Prevention of early neonatal pneumonia in the larger baby depends partly on anticipating the long list of conditions associated with intrapartum anoxia and/or trauma.

In the British Survey, pulmonary infection often spreads so rapidly that the time between the first symptom and death was a matter of only hours. The diagnosis was often obscured by the variability and protean nature of the clinical features. Cerebral irritation, hypothermia, vomiting, nonspecific deterioration, or even sudden

collapse were more common manifestations of neonatal pneumonia than signs directly referable to the respiratory tract. This often led to delay in diagnosis and treatment, especially for babies born at home. There was a higher neonatal death rate from pulmonary infections (1.4 per 1,000 total single births) in babies booked for delivery at home than in those booked for hospital delivery (1.1 per 1,000).

Acquired infection was found to play only a minimal part in early neonatal as opposed to late neonatal deaths, whether in the hospital nursery or at home. The risk of acquired infection in hospital has been reduced by such measures as rooming-in of the baby with the mother, reduction of handling procedures such as bathing and other skin toilets, and the prophylactic use of antibacterial creams or dusting powders, e.g., hexachlorophene. Many United Kingdom maternity hospitals have a standing cross-infection committee and undertake regular bacteriologic examination of nursery, patients, and staff. Treatment of nasal carriers may be effective with local antibiotics, e.g., neomycin, framycetin, or tyrothricin spray. The routine use is practiced in some nurseries of such antibiotics sprays as methicillin.

Some points of interest emerge from a comparison of neonatal deaths in March 1958 registered as dying from pneumonia with those found to have pulmonary infection in the British Perinatal Mortality Survey in the same month. Only 27 percent (71 out of 276) of babies registered as dying neonatally from pneumonia showed pulmonary infection as a major necropsy finding. In the remainder, necropsy revealed that the mature babies mainly died with intrapartum anoxia and/or trauma and the less mature with "respiratory distress syndrome." In a few instances, major internal congenital anomalies were present. Misleading conclusions as to the local and secular mortality trends of neonatal pneumonia may clearly result if allowance is not made for variations in quantity and quality of postmortem examination.

What then were the registered causes of death in those found at postmortem to have pulmonary infection in March 1958? As many as 215 out of 290 babies (74 percent) which were found to have pneumonia histologically had been registered as dying from other causes; of these, the most frequent causes registered were postnatal asphyxia and atelectasis, immaturity unqualified, brain or spinal injury, or hemorrhagic disease of the newborn.

Causes of Late Neonatal Death

In the British Perinatal Mortality Survey, late neonatal deaths accounted for only 2.5 deaths per 1,000 live births. There were only two major causes, congenital malformations and infections.

Congenital malformations caused 45 percent of these deaths and were mainly central nervous system, cardiovascular, and urogenital malformations (table F). The need for early diagnosis and rapid transfer for expert surgical treatment of operable malformations has already been stressed.

Infections accounted for 36 percent of all late neonatal deaths in the British Survey—the majority were in the lungs. Extrapulmonary infection was almost unknown as a cause of early neonatal death and was a rare cause of death in the late neonatal period, accounting for only one late neonatal death per 5,000 live births. Very

Table F. Percentage distribution of necropsies, and death rates at 7-27 days of age, by major findings: England, Scotland, and Wales, 1958

[Neonatal deaths for March 1958 are related to births estimated for the same month from the control week, March 3-9, 1958]

Major finding	Percentage distribution	Late neonatal death rate[1]
Total with necropsies----	100	2.2
Lethal congenital malformations-------	45	1.0
Pulmonary infections-	26	0.6
Other infections-----	10	0.2
Massive pulmonary hemorrhage---------	5	0.1
Other----------	14	0.3

[1]Deaths 7-27 days of age per 1,000 live births.

occasionally gastroenteritis, meningitis, brain abscess, or septicemia was found. Wider recognition of the need for lumbar puncture in any baby showing cerebral irritation or convulsions would lead to earlier diagnosis of meningitis.

Infection was an important risk when a baby was transferred home from a maternity unit in poor condition, and was often due to a hospital-acquired penicillin-resistant staphylococcus. It was concluded that very careful examination of babies, particularly those of high-risk mothers, must be made before discharge from maternity hospitals. Careful observation is essential in the days immediately after home-transfer. Infection was particularly common in babies of grandes multiparae or where the family was of poor socio-economic status. If evidence of infection is found in a baby after it has been sent home, it is vital to inform the maternity unit in which the birth took place, so that they may be aware of the potential source of an epidemic of sepsis.

Two other conditions are of interest in infant mortality, namely cot (crib) death and cold injury. Cook and Welch[25] found a well-defined cause in only 20 percent of cot deaths, including acute infections such as meningitis or septicemia, congenital heart disease, and renal congenital anomalies or renal vein thrombosis. In the remainder, no specific organisms or viruses were found on smear or culture, and no specific histology was present in lungs or elsewhere. They also made an epidemiological study and concluded that some of the nonspecific group might be due to cow's milk allergy. An inquiry into sudden death in infancy by the Ministry of Health[26] strongly suggested that unexpected death in infancy was associated with early bottle feeding and hypersensitivity to cows' milk, the risk of suffocation by soft pillows, and recent infection. Avoidance of pillows for young infants and complete breast feeding for the first 2 weeks of life were recommended.

Cold injury was first fully reported in 1957[27] and continues to contribute to neonatal and post-neonatal mortality in Britain in winter months but may occur at any season in any climate. Clinically, the hypothermic infant may show refusal to feed, lethargy, edema, sclerema, bradycardia, facial erythema, and may be icy cold to the touch. The rectal temperature is below 95 degrees Fahrenheit, and this is recordable only with a low-reading thermometer. Among predisposing factors may be intrauterine growth retardation, infection, congenital heart disease, cerebral birth trauma, asphyxia, and hypothyroidism. This condition, rarely reported in the United States, sometimes responds if diagnosed early to slow warming up to 97 degrees Fahrenheit, with supportive steroid therapy, oxygen, and antibiotic cover, while attention should be paid to remedying hypoglycemia.

BIOLOGIC AND ENVIRONMENTAL FACTORS

Maternal Age and Parity

Information on maternal age and parity has been available on birth registration since 1938. The influence of these factors on stillbirths and infant deaths is well documented and is particularly clearly defined in relation to stillbirths (table G). The risk of stillbirth increases with the age of mother except for the age group under 20 years in which the slightly raised rate probably reflects the influence of illegitimacy and primiparity. The rising risk with rising age is present in all parities but is most marked for primiparae and for women who have borne three or more children. The influence of maternal age is more marked in stillbirths due to maternal conditions and placental and cord conditions than in those due to fetal conditions. Among maternal conditions, chronic heart disease and toxemia are especially influenced by age.

Table H shows the stillbirth rate by parity in 1962. The figures relate only to legitimate births, because information about previous children is not sought on the registration of illegitimate births. These figures confirm the well-known influence of parity, with a relatively high risk in the first birth, the lowest risk in the second birth, and thereafter a rising risk in succeeding parities. This pattern is present in all age groups, but the risk of the first birth and of the higher parities is most marked in older women.

The risk of death in the first birth is particularly marked in those associated with toxemia. For stillbirths ascribed to this cause the rate in first births was 3.3, nearly 2½ times the rate in

Table G. Stillbirth rates, by age of mother and cause of stillbirth: England and Wales, 1962

Age of mother	Cause of stillbirth[1]			
	All causes	Maternal conditions (Y30-Y35)	Placental and cord conditions (Y36)	Fetal conditions (Y37-Y39)
	Rate per 1,000 total births			
All ages	18.1	5.1	5.1	7.9
Under 20 years	15.7	4.4	3.9	7.3
20-24 years	15.1	4.1	3.8	7.1
25-29 years	15.6	4.1	4.5	7.1
30-34 years	20.1	5.9	5.9	8.3
35-39 years	28.2	8.8	8.5	10.9
40-44 years	37.1	12.0	11.2	13.8
45 years and over	56.6	20.8	10.8	25.1

[1] Causes of death classified according to the Seventh Revision of the International Lists, 1955.

Table H. Stillbirth rates among legitimate births, by birth order and cause of stillbirth: England and Wales, 1962

Total number of previous live or stillborn children	Cause of stillbirth[1]			
	All causes	Maternal conditions (Y30-Y35)	Placental and cord conditions (Y36)	Fetal conditions (Y37-Y39)
	Rate per 1,000 total births			
Total	17.8	5.0	5.0	7.8
None	19.2	5.9	5.0	8.3
1	12.6	3.2	3.6	5.7
2	16.5	4.3	4.8	7.5
3	20.5	5.4	5.7	9.4
4	26.8	7.8	8.1	10.8
5	30.7	8.4	9.9	12.3
6	28.3	8.2	8.9	11.2
7	34.6	8.3	12.5	13.8
8	33.7	10.9	11.2	11.6
9	41.0	9.6	18.1	13.3
10 or more	39.5	16.6	12.5	10.4

[1] Causes of death classified according to the Seventh Revision of the International Lists, 1955.

second births (1.4). Stillbirths due to congenital malformations show comparatively little variation with age and parity. The variation is similar to that for all stillbirths but within a much narrower range.

The influence of maternal age and parity on neonatal and postneonatal death, as well as on stillbirth, was demonstrated in a study of the records of infant deaths linked with legitimate single births in England and Wales in 1949.[28] A fall in the mortality risk from the first to the second birth was apparent for neonatal death only in mothers over 25 years of age, whereas it is a constant feature for stillbirths at all maternal ages. Neonatal mortality rose in the higher parities and higher age groups, but the rise was not so marked as for stillbirths at comparable parities and ages. The extremes of youth and age within the childbearing period are both unfavorable factors in neonatal mortality, but the adverse effect of youth is particularly marked in women of relatively high parities for their age, i.e., mothers under 20 years bearing their second or later child and mothers under 25 years bearing their third or later child. Heady and Morris[29] showed that this relatively high risk of neonatal death for the children of young multiparae was present in the first week of life and influenced infant mortality on the first day and even the first few hours of life, in contradistinction to the low risk of stillbirth for young women in low parities.

In postneonatal death, mortality rose with rising parity (again most markedly for the relatively young multiparae), and fell with increasing age in each parity except for mothers over 35 years.

Thus, for stillbirths, increasing maternal age is an adverse factor in all parities, but in neonatal death and still more in postneonatal death, increasing maternal age to some extent mitigates the adverse effect of rising parity.

The study of the influence of age and parity in perinatal and infant mortality leads to the identification of certain high-risk groups, namely, women over 30 years of age having their first child, women over 35 years of age who have already had three or more children, and women over 40 years of whatever parity, all of whom are at higher than average risk of stillbirth. In addition, very young primiparae and young multiparae and women over 40 years have a higher than average risk of losing the baby by neonatal death; for the young multiparae the risk becomes more marked in the postneonatal period. The recognition of these and other high-risk groups influences not only clinical practice but also the planning and administration of maternity services and the preventive services for young children.

Past Obstetric History

A history of previous abortion, stillbirth, or neonatal death increases the risk of prenatal loss in subsequent pregnancies. The association of high parity with previous abortions seems to be particularly dangerous. Similarly a history of a previous low birth weight child is associated with an increase in perinatal mortality. The degree of the increased risk will vary with the cause of the previous perinatal loss. In the British Perinatal Mortality Survey in 1958 it was noted that a previous stillbirth or neonatal death multiplied the overall risk 2½ times and that a previous low birth weight baby doubled the risk. Previous toxemia, antepartum hemorrhage, or cesarean section was also associated with increased perinatal mortality in subsequent pregnancies, and here again the effect was aggravated by high parity.

Maternal Stature

The Survey in 1958 confirmed, on a national basis, the association of maternal height and perinatal loss noted in earlier studies in Aberdeen.[30] Short stature has been interpreted as a failure to realize the full growth potential because of poor environment. In the Survey, women whose height was 65 inches or more formed 30 percent of the total sample and the perinatal mortality of this group was 21 percent below the average. Women whose height was less than 62 inches formed 22 percent of the total sample and the perinatal mortality of this group was 14 percent above the average. The proportion of tall women (height of 65 inches or more) was found to be lowest in the North zone (North West England, Scotland, and Wales), higher in the Central zone, and highest in the South zone. The propor-

tion of tall women decreased from the professional to the unskilled socioeconomic groups. This class difference was present in each region and the regional difference, in each socioeconomic class. No particular cause of death was found to contribute disproportionately to the increased infant mortality among the offspring of short mothers.

Illegitimacy

For many years the proportion of illegitimate live births has been about 4 percent of all live births, except for increases during the two World Wars. During World War II the proportion rose to 7.0 percent and has never quite fallen to the prewar level since. In recent years the proportion has risen from 4.7 percent in 1955 to 6.0 percent in 1961. Illegitimate stillbirths also rose, from 6.5 percent of all stillbirths in 1958 to 7.6 percent in 1961. Illegitimate births used to be associated with mortality rates far in excess of the average for all births, but the rates were improving before World War II and have since been greatly reduced. Among illegitimate infants, late neonatal and postneonatal mortality rates have declined more rapidly than the average; and these infants are now at no disadvantage, in terms of mortality, after the first week (table 15). This is partly the outcome of the medicosocial work for the unmarried mother and her child that has been undertaken for many years by voluntary organizations and local authorities, partly the mother's improved economic circumstances helped by the maternity benefits payable since 1948, and, not least, partly the availability of medical care for mother and child without payment since 1948.

Stillbirth and early neonatal mortality rates for illegitimate births, though much reduced, are still above the average. A very high proportion of illegitimate births are first births; for example, 76 percent of the illegitimate births in the British Perinatal Mortality Survey in 1958, compared with 36 percent of the legitimate births were first births. On the other hand, unmarried mothers are younger than average; for example, in the same survey, 71 percent of unmarried mothers were under 25 years, compared with 34 percent of married mothers. Their youth should largely offset the high "first-birth risk" of stillbirth, though it may slightly increase the risk of early neonatal death. The crucial factor in higher perinatal mortality among illegitimate births is inadequate prenatal care arising from reluctance to seek medical advice. The problem is probably more widespread than the illegitimacy rate suggests. Not only were 6 percent of live births illegitimate in 1961, but a further 8 percent were extramaritally conceived and legitimated by marriage before the birth occurred. Reluctance to seek medical advice and consequent inadequate prenatal care is likely to be frequent in these pregnancies also.

Thus, there is certainly the possibility of further reduction of perinatal mortality by the reduction of illegitimacy or by intensified care for the unmarried mother and her child. On the other hand, in view of the steady fall of perinatal mortality in illegitimate births it is not likely that the slight rise in illegitimacy in recent years can have appreciably affected overall perinatal mortality.

Geographic Area

Rates for live births, stillbirths, and perinatal and infant deaths, averaged for the 3 years 1960-62 are presented for the standard regions of the country which have been devised for the purposes of the national statistical records of the General Register Office (table 16). Figure 2 shows the standard regions in outline and illustrates the relationship of regional infant mortality to the national rates in 1960-62. The numbers on the map give the infant mortality rate of each region as a percentage of the national rate. The heavy line separates those regions with rates above and below the national rate, all the former lying in the northwestern part of the country and all the latter in the south and southeast. This demarcation has not altered in broad outline during the present century, though the regional difference has narrowed a little in the last 30 years.

Reference to table 16 shows that the same pattern of variation holds for both the neonatal and postnatal components of the infant mortality rates and for the stillbirth and perinatal mortality rates. In each case the lowest rates are found in the southeastern part of the country and they increase in a northwesterly direction.

The slow trend toward reducing the geographic difference has been due chiefly to the earlier impact of immunization and antibiotic therapy on postneonatal mortality in the northwestern part of the country where respiratory and other infective conditions are more frequent.

The marked difference in mortality due to congenital malformations of the central nervous system (descending gradient from northwest to southeast) is a factor which is helping to maintain the regional variation in perinatal mortality.

Since the northwestern part of the country is more industrialized, the difference in urban and rural infant mortality have a bearing on regional differences. Table 17 shows the mortality rates for six conurbations and also for the aggregated conurbations and for the aggregates of all other urban areas and all rural areas. Each conurbation contains several towns and urban districts of varying sizes grouped around one or more large cities, together forming one continuously urbanized area though comprising many local government areas. Their populations range from roughly 1-2½ million, except for Greater London which has a population of 8 million.

With the exception of Greater London, all the conurbations are in the north and west of the country (fig. 2). In addition there are many other smaller industrial aggregations in the northwest and in Wales. All these aggregations and conurbations (except London) owe their development to the industrial revolution of the 19th century, which affected England before any other country. In the space of a few decades, much of the country changed from agricultural communities with local interests and local markets to teeming industrial centers of worldwide trade. When the inventions and mechanizations of the 18th and 19th centuries released the industrial upsurge, the potential for its development lay in the northwest, with its water power and coal fields. With industrial development came rapid urbanization and rapid increase in population: growth followed blindly on the demands of industry, with little or no regard for health and hygiene, until squalor and disease forced themselves on public attention. The worst of the resultant evils have by now been swept away, but many local authorities are still battling with a legacy of mean streets, bad housing, air pollution, and lack of open spaces resulting from the original, unconsidered structure of their townships. The description "urban" may still have very different implications when applied to an area that developed during the industrial revolution, to an area planned and built as a new town within the last 20 years, or to developments of intermediate years.

The mortality rates for the conurbations and other urban areas show the southeast to northwest rising gradient. The rates for the rural areas are lower than those for urban areas, but they also show the same geographic gradient (table 17). Thus the higher the mortality of the northwestern part of the country, though no doubt influenced by a greater degree of urbanization (especially long-established urbanization), is certainly not dependent on this.

In addition to the question of industrialization there are, even in a country as small as England and Wales, regional differences in climate and terrain that are worth noting in the context of infant mortality. The north of the country is, on the average, colder than the south. The west, especially the northwest, has a higher rainfall. With the rainfall go cloudier skies and less sunshine, which may be diminished still further in densely urbanized areas by air pollution. Much of the northwestern part of the country is mountainous and the rural areas are quite different in character from those in the southeast. Among the mountains of Wales and the Lake District and in the Yorkshire moorland country, transport is rather more difficult, medical and welfare services are not quite so readily available, climatic conditions are apt to be more severe, and altogether life tends to be rather more austere than in the rural areas of the southeast. Thus the northwestern part of the country presents some natural handicaps for the rural population, while some of its urban population still feels the long-term manmade handicaps left over from the industrial revolution. But as the evils of uncontrolled urbanization have been and still are being greatly reduced, so also modern transport and communications are improving conditions in even the most remote rural areas. Neither of

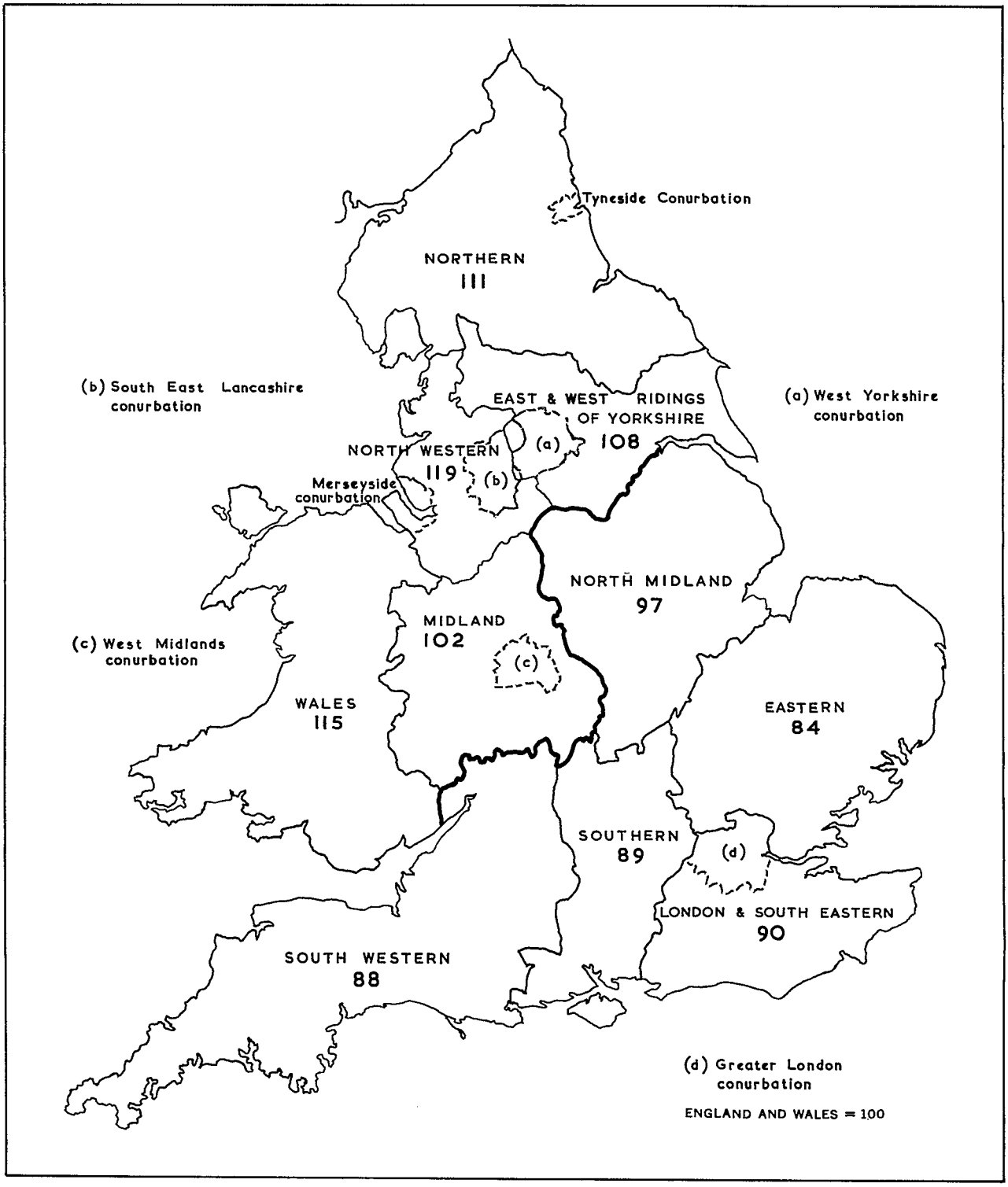

Figure 2. Ratios of infant mortality rates for standard regions to the national rate: England and Wales, 1960-62.

these factors can be measured, but each must be contributing to the reduction of regional differences in infant mortality.

Socioeconomic Class

After the 1911 census, the Registrar General introduced the grouping of occupations to form socioeconomic classes for the purpose of medicosocial analyses and research. Originally, occupations were grouped into eight categories, but in 1921 this was reduced to five and this regrouping has been continued. The percentage distribution of the population in the five socioeconomic classes as enumerated in the 1951 and 1961 census is as follows:

Social class	*1961*	*1951*
I (High)	3.3	3.0
II	15.6	15.7
III	48.8	52.4
IV	20.2	16.9
V (Low)	7.7	11.9
Not classified	4.4	-

Married women were enumerated according to the husband's social class. In 1961, members of the armed forces and persons with inadequately described occupations were included in "not classified"; in 1951, the armed forces appeared in social classes I and III.

The outstanding feature of infant mortality in relation to socioeconomic class is not so much that there are differences between classes, but that there has been no narrowing of these differences in the past 50 years. Infant and perinatal mortality rates increase steadily from class I (high) to class V (low). The constancy of the class gradient was demonstrated by Morris and Heady[31] in a study of social and biological factors in infant mortality in 1949. It was shown that in 1911 the neonatal mortality rates in class I and class V were, respectively, 26.8 and 42.5 and in 1949-50, 13.5 and 21.9. Each rate had been halved and the relationship between them remained unaltered. Similarly in 1911, the postneonatal mortality rates in class I and class V were, respectively, 28.3 and 110.0; in 1949-50 the comparable rates were 4.9 and 17.9. Each had been reduced to about one-sixth of the earlier figure and the relationship between them remained unchanged. Proportionate reductions of similar magnitudes occurred in the rates for the intermediate classes, and the gradient remained virtually the same in 1911, 1921, 1931-32, 1939, and 1949-50.

The position is the same for stillbirths, for which rates by social class were not available until 1939. In the succeeding 10 years the stillbirth rate fell by about one-third in each social class, maintaining the same gradient as before. In 1949, the rate ranged from 15.7 in class I to 25.7 in class V. Morris and Heady showed that not only have the main social classes maintained their differentials, but so also have particular occupations despite changes of a totally different nature in the circumstances associated with those occupations.[31]

In the British Perinatal Mortality Survey, perinatal mortality ranged from 23 percent below average in the professional, managerial, and supervisory families to 28 percent above average in the family of the unskilled worker (table 18). These differences are to some extent a reflection of differences in the age and parity makeup of different social classes. However, detailed factor analysis of this point[32] showed that adjustments for age and parity made no appreciable difference to the social class gradients in perinatal mortality. Regional variations in perinatal mortality were also not explicable in terms of the concentration of high social classes in the southern parts of the United Kingdom, because social class gradients persist in all regions. Analysis of the rural-urban perinatal mortality rates showed a slightly better rate for a given social class in rural compared with urban populations.

Analysis within each social class of mortality rates for each major cause of death in the Survey of 1958 is shown in table 18. The increased mortality associated with low social class shows a disproportionately large contribution from the group with intrapartum anoxia and/or trauma and from lethal congenital malformations, in particular of the central nervous system. Surprisingly, there was little difference in the proportion of deaths from "respiratory distress syndrome" among the social classes.

The precise influences which increase perinatal mortality in the woman of low social class are difficult to evaluate. Poverty, unsuitable housing, poor nutrition both in childhood and adult life, poor physique, short stature, increased incidence of anemia, higher parity, shorter pregnancies, and smaller babies are all important factors. It also seems clear that maternity services are not utilized so well by women of low social class and that standards of prenatal care, bookings for hospital delivery, and medical supervision during labor are all lower in women of higher parity and low social class.

The sociologic aspects of the Survey have been analyzed in broad outline by Illsley and Kincaid.[33] Among the more interesting of their conclusions is the fact that the gap in perinatal mortality between social classes I and V has actually widened in the last decade, despite the free availability of medical and welfare services, and despite higher wages and a rising standard of living. Clearly the sociologic factors contributing to perinatal mortality are not to be corrected in one generation.

Attempts to explain the constancy over the years of the disparity between the socioeconomic groups lead to a wide field of social and demographic studies that can only be briefly mentioned. Improving social and economic conditions, and even improving medical skills, can give a quick return, in terms of health, only up to a point. There must inevitably be a time lag in improving what have been called the "capital assets" of community health, such as housing and education. Greater prosperity cannot suddenly change, for example, the bleak drabness of a mining village nor the congestion of an overcrowded town. Nor does it immediately alter the traditional way of life of a community which may determine its responsiveness to change, as for example by acceptance of hospitalization for confinement. Nor, for the adult women of a community, can it alter the preadult social and nutritional experience which has already determined their physique and stature. Thus, by reason of environment, culture, and constitution some time lag is inevitable in the response to economic and medicosocial leveling, though the continuance of the same degree of disparity for 50 years seems too long to be wholly explained on these lines.

A part of the explanation probably lies in the movement between the socioeconomic classes. The relative size of the professional and technical group is increasing while the group of semiskilled and unskilled workers is tending to diminish, and the migration between the groups is such as to maintain disparity in mortality. It is common knowledge that members of a family handicapped by ill health may drift into less well-paid occupations, while the healthy will maintain or improve their status. Illsley and Kincaid[33] have confirmed earlier studies in Aberdeen demonstrating that marriage may also have a selective effect. Women who marry men of the same or higher socioeconomic class differ from those marrying into a lower socioeconomic class. They are, on the average, taller; they have reached a higher level of education; and, if in work themselves before marriage, they have achieved a better occupation status. With these attributes goes a lower perinatal mortality. Thus the migration between classes, at least so far as it arises for reasons of health or marriage, will tend to intensify the relatively high mortality experience of the lower socioeconomic groups and, so, to maintain the disparity between the groups, or even to increase it, as was shown to have occurred in 1958.

Combined Effects

The study of environmental and biologic factors in perinatal mortality leads to two conclusions: (1) that the outcome of a pregnancy is influenced by circumstances which reach back over many years and shape the mother's health, physique, and social experiences from her own conception onward and (2) that if the pregnancy is one with a higher than average risk of perinatal mortality it will require a commensurate high standard of care to minimize the risk, though it cannot alter the causal antecedents.

The long-term influence probably provides the explanation of the halt in the fall of the perinatal mortality rate in the early 1950's. The young women who were coming to the childbearing ages between 1950 and 1955 were themselves born in the late 1920's and the early 1930's. This was a period of industrial unrest, high and widespread unemployment, and severe economic de-

pression. During this time the maternal mortality rate, which had been fairly stable for 15 years, began to rise and reached its maximum in 1934. The stillbirth rate was not known until 1927, but from then until 1936 it was virtually stationary, with its highest point in 1933. The early neonatal mortality rate had been slowly falling since 1906 but came to a halt in the late 1920's and rose a little to reach its highest point in 1933. All the obstetric indexes suggest that this was an unfavorable time for the neonate, particularly from 1929 to 1934.

In these 6 or 7 years (1929-34) unemployment, poverty, and malnutrition were more widespread than in the preceding years and more so than they have ever been since then. It seems reasonable to assume that these years left their imprint on the physique of children born at this time. When they reached womanhood and childbearing that imprint was seen again in the perinatal mortality of their children.

The short term influence of environmental and biologic factors should lead to the shaping of maternity services and obstetric care in relation to the high-risk groups. Some of these have already been noted in discussing the influence of age and parity, the most important ones being women over 30 years in their first pregnancy, women over 35 years who have already had three or more children, and all women over 40 years, with, in addition, the smaller groups of primigravidae under 20 years and younger multiparae with relatively large families for their age. To these groups must be added the small but very high-risk group of multiple pregnancy, the women who have previously had a stillbirth, neonatal death, or premature delivery, the unmarried mothers, and the women of short stature. Obviously a woman who has had any abnormality or difficulty in a previous pregnancy must also be regarded as at a higher than average risk subsequently, but most will probably fall into one or another of the groups already mentioned. In considering the perinatal mortality risk in all these groups added weight must be given according to the area in which the mother lives and her socioeconomic class.

These groups with a higher than average risk of perinatal death overlap one another and altogether account for about 70 percent of all births. It has been the policy of the Ministry of Health for the past 10 or 12 years that women in these groups should have their confinements in hospital and that maternity hospital beds should be sufficient to provide for 70 percent of all births. This figure has not yet been attained in all areas, though it is surpassed in many large towns.

In emphasizing the value of confinement in hospital it is not intended to imply that hospitalization, *per se*, is the most important factor, though obviously in many circumstances the facilities available in a well-equipped hospital may be essential. In this country, hospital maternity beds are under the charge of specialist obstetricians and therefore when a mother books for her confinement in hospital her prenatal and obstetric care becomes the responsibility of a specially qualified doctor whose whole time is devoted to obstetrics and gynecology. If, on the other hand, she has her confinement at home (or in a general practitioner maternity unit) then the responsibility for her prenatal and obstetric care rests with a doctor who is in general practice and whose experience in the field of obstetrics is therefore unavoidably slight by comparison with that of the full-time specialist. For this reason it is considered that only those women for whom a normal pregnancy and confinement can be confidently predicted, i.e., most of the second and third pregnancies under 35 years, should be confined at home, and that all those in the high-risk groups should be the responsibility of the specialist hospital services throughout their pregnancy and confinement.

For many years confinement at home was the traditional custom in this country. In 1927, 85 percent of all births occurred at home. Just before World War II, in 1938, the proportion had fallen to 60 percent. By 1950 it was 40 percent and in 1963, 33 percent. Thus in the space of 25 years the proportions of home and hospital confinements have been reversed. This reversal of the tradition of earlier days, coupled with the lack of any new hospital building during World War II and for several years subsequently, began to put a considerable strain on the hospital maternity service by the 1950's. This was intensified when the birth rate began to rise in 1955 and continued to rise thereafter. This rising pressure on hospital maternity accommodation has made

the selection of cases for hospital (i.e., specialist) care a matter of increasing importance in this country if the available facilities are to be used to the best advantage in terms of the prevention of perinatal mortality. The degree of selection that is necessary varies in different areas according to the available hospital beds.

In the country as a whole the optimum selection has not yet been achieved, partly because of failure to appreciate fully the potential risk of perinatal mortality and partly because of the reluctance of some mothers, especially the older women with large families, to accept hospital confinement. Thus in 1959, of women who were over 35 years old and had four or more children, 45 percent were confined at home, and among primigravidae over 35 years old, 16 percent were confined at home. In 1964 these two proportions had been reduced to 25 and 11 percent respectively, indicating improving, but by no means optimum, selection. Similar failure to arrange for specialist care in these and other high-risk groups was demonstrated in the Survey in 1958 and was associated with high mortality rates, especially in those cases for whom emergency admission to hospital had eventually to be arranged.

Opinions differ in Britain as to whether all women should be encouraged to have their confinements in hospital and therefore whether the aim should be to provide sufficient hospital facilities for all births. But whatever the ultimate trend, the present position is that in most areas some degree of selection for hospital care is necessary. Further improvement of perinatal mortality will be influenced by the adequacy of the selection.

PREGNANCY COMPLICATIONS AND DISORDERS OF MATURATION

Preeclamptic Toxemia and Essential Hypertension

This is probably the most important maternal association of perinatal death. No less than 27 percent of women in the control week of the British Perinatal Mortality Survey had a diastolic blood pressure greater than 90 millimeters at some time in the last trimester (table 19). A retrospective diagnosis of toxemia, by the standard criteria of Eastman, was not possible in this Survey and the maximum diastolic blood pressure therefore was used.

Increasing severity of diastolic hypertension was associated with substantial increase in perinatal mortality. Essential hypertension was diagnosed when diastolic blood pressure was above 90 millimeters in the first half of pregnancy, and this was also associated with increased perinatal mortality. All other women with raised diastolic blood pressure in pregnancy were divided empirically into mild, moderate, and severe toxemia (table 19). All grades of toxemia, as compared with the normotensive state, were associated with some increase in the incidence of antepartum hemorrhage. Early delivery was significantly more frequent only when the diastolic pressure was greater than 110 millimeters or when toxemia was complicated by proteinuria.

Analysis of the individual toxemic groups contributing to perinatal mortality shows that, for diastolic pressures up to 109 millimeters, the increase is entirely due to a rise in the proportion of fetal deaths before and during labor from antepartum stillbirth and from intrapartum anoxia and/or trauma. These are further increased in the severe category where in addition there is some increase in early neonatal deaths from "respiratory distress syndrome."

The increase in the "other" group found in severe toxemia was due to the syndrome of massive pulmonary hemorrhage which was virtually confined to the baby suffering from intrauterine malnutrition. Essential hypertension also produced an increase in "respiratory distress syndrome" deaths.

It can be concluded that the effect of toxemia on the fetus was two-fold. First, severe toxemia was associated with an increase in premature delivery, with an inevitable death rate from the causes associated with preterm delivery. This increase can be partly attributed to accidental hemorrhage associated with the accompanying hypertension and also in part to induction for deteriorating hypertension. Secondly, placental reserve is reduced, leading to antepartum stillbirth or fetal death in labor from anoxia.

A further important factor in perinatal mortality associated with toxemia was prolongation of pregnancy past term. The increase in perinatal

mortality in post term pregnancy was much accentuated in the presence of toxemia and this increase occurs in the category of antepartum stillbirth (fig. 3). Here the accurate assessment of maturity is obviously very important. Because of this hazard, most British obstetricians prefer to induce labor at term in women with toxemia. Induction before term is reserved for the severer grades, or when hypertension is complicated by proteinuria. Early induction may also be used when the fetus fails to grow.

A vigorous attack upon the problem of late hypertension in pregnancy has been made in several British centers.[34] Careful control of weight gain, close prenatal supervision, and prenatal admission for rest if preeclampsia develops have reduced the incidence of proteinuria, eclampsia, and severe hypertension and thus have produced a fall in perinatal mortality. However, it is possible that intensive care to any high-risk group will reduce the perinatal mortality and the improvement may not be directly related to the reduction in blood pressure alone. Bed rest is known to improve uterine blood flow and prenatal admission will guarantee the immediate availability of an expert obstetrician in the event of an emergency. Since the 27 percent of women with toxemia or essential hypertension in pregnancy gave birth to very nearly half the perinatal deaths, this is a very obvious high-risk group.

Bleeding

In the British Survey, 94 percent of women having single babies had no bleeding at all during pregnancy, and their infants experienced a low perinatal mortality and a low incidence of delivery before 36 weeks of gestation (table 20).

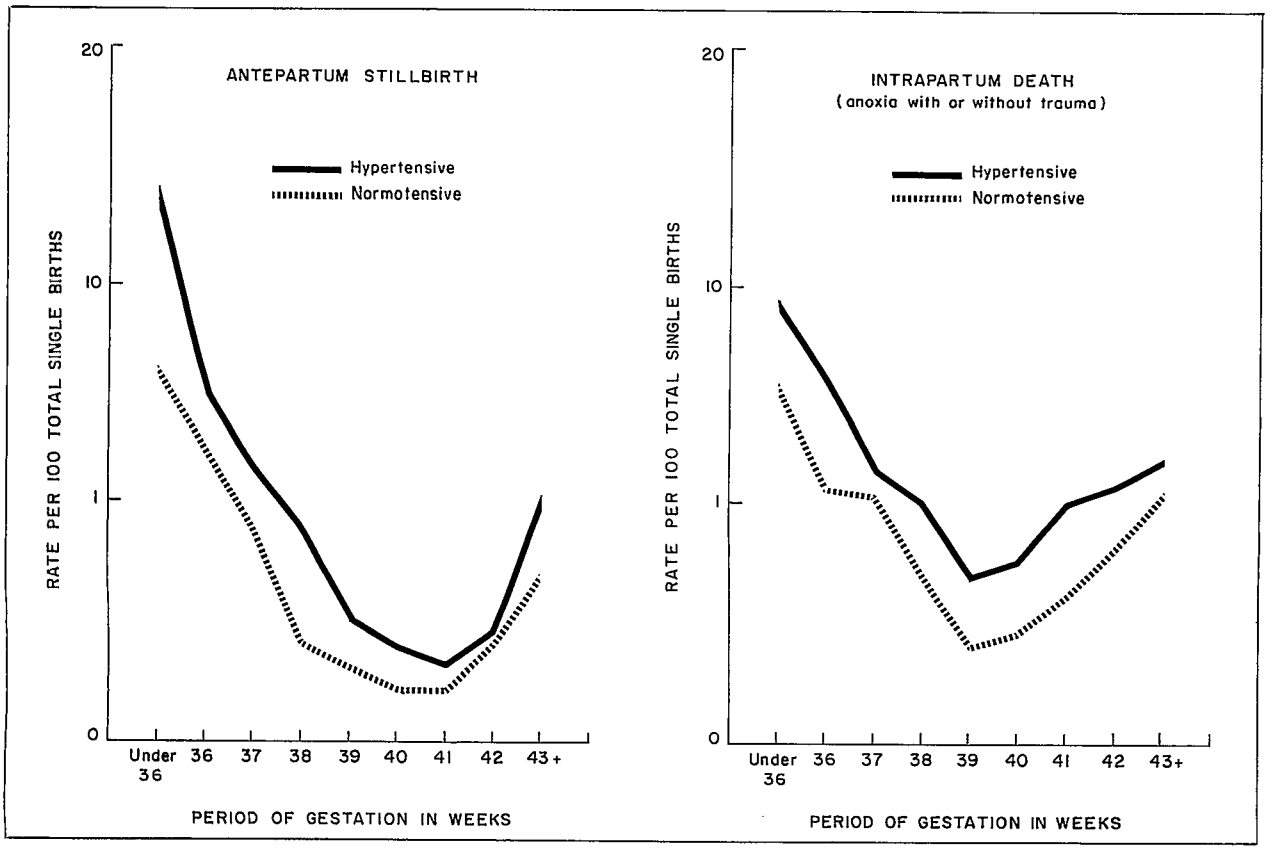

Figure 3. Perinatal mortality rates for antepartum stillbirth and intrapartum death and for hypertensive and normotensive mothers, by week of gestation: England, Scotland, and Wales, 1958.

(Perinatal deaths for March 1958 are related to births estimated for the same month from the control week, March 3-9, 1958)

The commonest form of bleeding was the threatened abortion (2.9 percent), which was defined as vaginal bleeding before the 28th week of pregnancy. This is probably a considerable underestimate of the true incidence of threatened abortion. Perinatal mortality was increased after threatened abortion at all gestations and even when no further bleeding occurred after 28 weeks.

Accidental antepartum hemorrhage was diagnosed when a painful tender uterus was accompanied by vaginal bleeding or retroplacental clot. In 43 percent of cases of accidental hemorrhage, preeclamptic toxemia was also present. More than half the babies died, mostly at time of hemorrhage, or during the closely following labor. These events have all been classified as deaths from intrapartum anoxia and/or trauma. The strong association of accidental hemorrhage with early delivery is reflected by a large increase in deaths from "respiratory distress syndrome."

Placenta previa was diagnosed when a low-lying placenta was felt on examination or seen at cesarean section. Perinatal mortality was considerably less than with accidental hemorrhage and was due mainly to a high death rate for intrapartum anoxia and/or trauma and an increase in the number of early neonatal deaths from "respiratory distress syndrome."

Unspecified antepartum hemorrhage is a residual group in which there was insufficient information to make a positive diagnosis of either accidental hemorrhage or placenta previa. This is the commonest type of bleeding in the last trimester, and its outcome is very similar to that of placenta previa. Its etiology is unknown but it includes undiagnosed placenta previa, marginal sinus rupture, and bleeding from extraplacental sites.

Possible measures to counter the high perinatal mortality associated with antepartum hemorrhage depend on the type of hemorrhage. If the fetus in utero survives an accidental hemorrhage, a decision as to active intervention need not be based entirely on the former poor prognosis which characterized liveborn infants of low gestation. Improvement in perinatal mortality associated with placenta previa has been reported with rigorous bed rest for the remainder of the pregnancy.

Weight Gain

The association between excessive weight gain and increased incidence of maternal hypertension on the one hand and of low birth weight babies and increased perinatal mortality on the other hand is generally accepted in this country.[35] Poor weight gain during pregnancy is also associated with an increased incidence of low birth weight babies and increased perinatal mortality.[37] It is not yet clear whether the low birth weight babies associated with disorders of weight gain are due to early delivery or to intrauterine growth retardation.

Smoking

The Survey confirmed the well-documented association of smoking in pregnancy with an increased incidence of low birth weight babies and, to a lesser extent, of curtailed gestation.[36-38] There was significantly higher stillbirth and neonatal mortality among babies whose mothers regularly smoked one or more cigarettes per day after the 20th week of pregnancy. The difference in perinatal mortality between smokers and nonsmokers did not seem to be due to differences in age, parity, or social class.[39]

Anemia

When the hemoglobin level during pregnancy was below 60 percent (8.9 grams), perinatal mortality in the Survey was nearly twice the national average. This excludes cases of anemia following antepartum hemorrhage. Lesser degrees of anemia were not associated with any increase in mortality. Anemia is strongly correlated with social class and high parity, both of which are also associated with high perinatal mortality. However, mothers with anemia are clearly another high-risk group deserving intensive care during pregnancy and labor.

Gestational Maturity

The problem of spontaneous premature labor represents a major unsolved etiologic factor in perinatal mortality. In at least half the cases in the Survey, the etiology of delivery before the

36th week was unknown. In one-third of the women delivering before the 36th week, essential hypertension or toxemia was present, with a high incidence of severe hypertension. One in six of these early deliveries was accompanied by antepartum hemorrhage. The influence of hydramnios is difficult to assess, but it seems to play only a small role in the initiation of premature labor. Variation in social class or parity had little effect on the incidence of premature delivery, but maternal age under 20 years significantly increased the incidence. The effects of gestational maturity on perinatal mortality in the Survey are shown in table 21. Analysis of individual causes of death shows that the largest contributor in the early weeks of the last trimester was neonatal death from "respiratory distress syndrome." In labor, mortality was highest from intrapartum anoxia and/or trauma. The large "other" group in table 21 was due to the presence of congenital malformations (mostly anencephaly) delivered at low gestations.

Perinatal mortality reached its minimum in women delivering at 40-41 weeks of gestation. Half the deaths at this optimal period were due to intrapartum anoxia and/or trauma. More babies died of this group of causes in this gestation interval (40-41 weeks) than died at all gestations from "respiratory distress syndrome." Preterm delivery in the Survey was therefore numerically much less important as a factor causing perinatal mortality than intrapartum death at term.

The increase in perinatal mortality after 42 weeks of gestation was due largely to increases in the group intrapartum anoxia and/or trauma and in the rate for antepartum stillbirth. The adverse effects of hypertension associated with prolonged pregnancy in these two categories have already been noted (fig. 3). Accurate knowledge of the gestational age is clearly of major importance here.

Gestational Maturity and Low Birth Weight

In studying pregnancy and labor complications associated with low birth weight (2,500 grams or less), it must be realized that their incidence will vary according to length of gestation. In table 22, low birth weight babies are shown in three different gestational groups, and the incidence of some maternal factors is shown for each group.

The important associations of the low birth weight baby delivered at or after the 39th week (the small-for-dates baby) were primiparity, low maternal stature (under 5 feet), hypertension in pregnancy, and fetal distress in labor. These were the maternal associations or complications which occurred more frequently in this gestation group than in the others. Conversely, among the deliveries of low birth weight babies before the 36th week the complications that were more common in this group than in the other gestation groups were breech delivery and previous perinatal death.

Table 23 shows for low birth weight babies, in the same three gestational groups as in the previous table, the causes of perinatal death, excluding macerated stillbirths and congenital malformations. Low birth weight babies born before the 36th week are seen to have very high perinatal mortality (37 percent). The two major causes of death were intrapartum anoxia and/or trauma and "respiratory distress syndrome" (i.e., hyaline membranes, intraventricular hemorrhage, or first-week deaths with no histological lesion). Together these two groups make up nearly three-quarters of these deaths. In the intermediate gestations (36-38 weeks) the mortality dropped to 8.2 percent and intrapartum anoxia and/or trauma accounted for half of the deaths. Perinatal mortality in low birth weight babies was lowest (5.3 percent) in those who were of high gestation, and again death from intrapartum anoxia and/or birth trauma was the commonest individual cause. Good intrapartum as well as neonatal care is essential to the survival of the low birth weight baby at all gestations.

The prognosis of surviving low birth weight babies also varies according to gestational age. Followup studies by McDonald [40,41] on 1,100 babies weighing less than 1,800 grams revealed two clearly distinct varieties of neurological handicap at the age of 7 years, depending on gestational maturity. Low birth weight babies of low gestation showed increased risk of spastic diplegia, whereas low birth weight babies of higher gestation showed an increased risk of mental retardation, convulsions, or cataract. The former

may be due to immature state of development of the pyramidal tracts and related parts of the central nervous system. The latter may be related either to oxygen-lack during labor, known to be a danger for the glycogen-depleted small-for-dates baby, or, for a similar reason, symptomatic neonatal hypoglycemia.

The definition of the small-for-dates baby is urgently in need of clarification. Gruenwald[42] has suggested two standard deviations below the mean weight for gestational age; Warkany and others[43] suggest a more stringent criterion of 40 percent underweight. Both of these require accurate knowledge of gestational age and of mean weights for the appropriate ethnic group. In the past the difficulties of obtaining reliable information from the mother as to the date of the last menstrual period have been exaggerated. The usefulness of early assessment of maturity during pregnancy is worth reemphasizing. In general, in Britain obstetricians and pediatricians have been insufficiently aware of the special problem of the baby who is unexpectedly underweight for gestational age. The designation "good premature" which has been given to these babies in the past is not supported by their perinatal mortality.

Classification of Birth Weight and Gestation

When studying the effect of birth weight and gestational maturity, it is clearly an advantage to use recognized and reproducible groupings. The World Health Organization defines as low birth weight all babies weighing 2,500 grams or less at birth. Where the birth weight is not known, the baby is considered to be premature when the gestation period is less than 37 completed weeks (259 days or less). Material from the British Perinatal Mortality Survey has therefore been specially classified in the above WHO categories of birth weight and gestational maturity (table J). Babies of low birth weight (2,500 grams or less) and babies of full size (over 2,500 grams) were each subdivided according to whether they were delivered preterm (under 37 completed weeks) or at full-term (37 weeks and over). This produced four groups of babies, namely: low birth weight preterm, full-size preterm, low birth weight full-term, and full-size full-term babies. The deaths were classified likewise with two omissions: congenital malformations and macerated stillbirths, in view of the special relationship of their birth weight to gestation. In 13 percent of the deaths included in the table and 11 percent of all births, gestation and/or birth weight was not known.

Table J shows that nearly half of the preterm babies in the Survey were full-size by birth weight (over 2,500 grams). More than half of the low birth weight babies were born at or near full-term (37 weeks or more). These figures justify the use of the four gestation-birth weight groups referred to above.

The *full-size full-term baby* accounted for 81.2 percent of all single births. This group had a very small risk of stillbirth or neonatal death (less than 1 percent). The mortality is seen to be very much higher in each of the other three birth weight-gestation groups which together formed 7.9 percent of births but 47.1 percent of stillbirths and neonatal deaths (table J). The contribution to mortality made by these three high-risk birth weight-gestation groups differed according to the stage of labor and day of death. It was only 22 percent in the case of deaths in the second stage of labor, which conversely is a time when full-size full-term babies face their greatest danger due to risk of anoxia in labor. It rose to 66 percent between 30 minutes and 24 hours, and 56 percent of deaths between 1 and 7 days.

The *low birth weight preterm baby* is seen in table J to have 8.0 percent risk of death in labor and a 16 percent mortality in the first week of life. The latter is mainly due to deaths from "respiratory distress syndrome." This group of low birth weight preterm babies made up 55.1 percent of all those dying after 30 minutes but before the end of the first day of life, a period which has been understandably resistant to improvement in mortality.

The *full-size preterm babies* are important since they are a high-risk group but are not officially premature by weight. This group had a first-week mortality which was over six times that of the full-size full-term baby (table J).

The *low birth weight full-term baby* has a higher mortality than babies of similar gestation but average weight. They are the small-for-dates

Table J. Percentage distribution of births, stillbirths, and neonatal deaths by maturity; percentage distribution and death rates for stillbirths and neonatal deaths by maturity and time of death: England, Scotland, and Wales, 1958

[Includes total single births for control week, March 3-9, 1958. Stillbirths and neonatal deaths for March-May 1958 are related to estimated births for the same months. Excludes macerated stillbirths and deaths from congenital malformations]

Time of death	Number	Percent	Index of maturity				
			28-36 weeks		37 weeks and over		Unknown[1]
			2,500 grams or less	More than 2,500 grams	2,500 grams or less	More than 2,500 grams	
		Percentage distribution by maturity					
All births	16,994	100.0	2.7	2.1	3.1	81.2	10.8
Total stillbirths and neonatal deaths	4,111	100.0	33.7	5.0	8.4	39.9	13.0
Stillbirths							
First stage of labor	1,172	100.0	29.1	6.3	8.1	42.3	14.2
Second stage of labor	783	100.0	12.1	3.4	6.9	66.2	11.4
Neonatal deaths							
Under 30 minutes	112	100.0	18.7	9.8	5.4	48.2	17.9
30 minutes-23 hours	978	100.0	55.1	4.6	6.2	20.8	13.3
1-6 days	828	100.0	39.7	3.9	12.8	31.5	12.1
1-3 weeks	238	100.0	24.8	7.1	10.5	44.5	13.1
		Percentage distribution by age at death					
Total stillbirths and neonatal deaths	4,111	100.0	100.0	100.0	100.0	100.0	100.0
Stillbirths							
First stage of labor	1,172	28.5	24.6	35.9	27.4	30.3	31.2
Second stage of labor	783	19.0	6.9	13.1	15.6	31.6	16.5
Neonatal deaths							
Under 30 minutes	112	2.7	1.5	5.3	1.7	3.3	3.7
30 minutes-23 hours	978	23.8	38.9	21.8	17.6	12.4	24.2
1-6 days	828	20.1	23.8	15.5	30.5	15.9	18.7
1-3 weeks	238	5.8	4.3	8.3	7.2	6.5	5.8
		Rate per 100 specified deliveries					
Total stillbirths and neonatal deaths	4,111	2.0	25.4	4.8	5.5	1.0	2.4
Stillbirths							
First stage of labor	1,172	0.6	6.3	1.7	1.5	0.3	0.7
Second stage of labor	783	0.4	1.7	0.6	0.9	0.3	0.4
Neonatal deaths							
Under 30 minutes	112	0.1	0.4	0.3	0.1	0.0	0.1
30 minutes-23 hours	978	0.5	9.9	1.0	1.0	0.1	0.6
1-6 days	828	0.4	6.0	0.7	1.7	0.2	0.4
1-3 weeks	238	0.1	1.1	0.4	0.4	0.1	0.1

[1] Birth weight and/or gestation not specified.

Table K. Percentage distribution of induced deliveries and stillbirth and neonatal mortality rates, by indication for induction of labor: England, Scotland, and Wales, 1958

[Includes total single births for control week, March 3-9, 1958. Stillbirths and neonatal deaths for March-May 1958 are related to estimated births for the same months]

Indication for induction of labor	Percentage distribution of induced deliveries	Stillbirths and neonatal deaths per 100 total births
Preeclamptic toxemia and essential hypertension	33.8	3.5
Prolonged pregnancy	37.2	2.3
Preeclamptic toxemia (essential hypertension) and prolonged pregnancy	5.7	2.0
Small pelvis	2.0	2.2
Rh antibodies	3.1	9.9
Antepartum hemorrhage	3.4	28.0
Unstable lie	1.4	1.7
Intrauterine deaths and congenital malformations	1.9	-
Other conditions	11.4	3.2

babies and their fate is interesting in view of the association with intrauterine malnutrition and the possibility of subsequent metabolic changes in the infant. This group of small full-term babies comprised 3.1 percent of all births in the Survey but was responsible for no less than 30.5 percent of the deaths at 1-6 days of age, the period of maximum danger of hypoglycemia. The mortality in labor and on the first day of life was also relatively high, though still much less than that of preterm low birth weight babies.

COMPLICATIONS OF LABOR

Induction of Labor

Some form of medical or surgical induction of labor was used for 13 percent of mothers in the British Survey. The percentage distribution of the indications used for induction of labor are shown in table K, with the perinatal mortality associated with each indication. Naturally, some indications are associated with a higher mortality than others. Hypertension and prolonged pregnancy were the commonest indications.

The methods of induction which were used are shown in table L. The traditional castor oil, bath, and enema was most commonly used, followed by high amniotomy. Mortality comparisons of different methods of induction are not meaningful because of different indications, making it impossible to assess accurately the risks of induction to the fetus. After both low and high amniotomy, about 1 in 20 cases was subsequently delivered by cesarean section. One chief hazard of induction would therefore seem to be an increased

Table L. Percentage distribution of induced deliveries, by method of induction of labor: England, Scotland, and Wales, March 3-9, 1958

[Total single births only]

Method of induction	Percentage distribution
Total	100.0
Low amniotomy alone	15.4
High amniotomy alone	20.0
Amniotomy alone, site of rupture unspecified	12.3
Amniotomy and oxytocin	11.0
Oxytocin alone	4.8
Oil, bath, and enema with oxytocin	8.4
Oil, bath, and enema without oxytocin	28.2

cesarean section rate and its attendant risks. The neonatal death rate from pulmonary infection was twice as high after high amniotomy as after low amniotomy and rose progressively after 24 hours of life. The vexed question of whether induction is less dangerous to the fetus than prolongation of pregnancy past term[44] could not be answered from the data of the Survey because of difficulties in comparing criteria for induction in different centers.

The problem of induction is closely connected with recognition of the failing placenta during the last trimester of pregnancy. This is difficult on clinical grounds and even by means of placental function tests. Serial measurements of urinary estriol levels are considered the most reliable tests in this country,[45] although not all investigators agree as to their value.[46] Persistently low levels or a fall from previously normal levels seem to be associated with reduced fetal growth[47] and an increased perinatal mortality. However, these measurements are laborious and expensive and at present are really suitable only for choosing the optimum time of delivery in the known high-risk case. The problem of a simple test for the routine detection of placental dysfunction is as yet unsolved.

Length of Labor

The length of the first stage of labor was 6-24 hours in 65 percent of primiparae in the Survey. Perinatal mortality was increased in primiparae when the first stage was less than 3 hours or more than 48 hours. Labors of less than 3 hours were more common in multiparae, again with a slight increase in perinatal mortality. In all births first stages longer than 24 hours were associated with increased perinatal mortality. In both primiparae and multiparae the increases in mortality with unfavorable length of labor were due largely to an increase in the number of deaths from intrapartum anoxia and/or trauma.

The second stage of labor lasted less than 2 hours in 83 percent of primiparae and in 92 percent of multiparae. Second stages of less than 30 minutes were associated with an increased perinatal mortality in primiparae but not in multiparae. Mortality started to increase when the second stage lasted more than 2½ hours in primiparae and 2 hours in multiparae. Once again the increased mortality was due to intrapartum anoxia and/or trauma.

The interval of time between rupture of the membranes and delivery was less than 3 hours in 60 percent of all cases regardless of parity. Mortality started to increase when the membranes had been ruptured for more than 24 hours and in this case was largely due to an increase in the number of babies dying of pulmonary infection. There was also an increase in deaths from intrapartum anoxia and/or trauma, probably because of the association with prolonged labor.

Analgesia in Labor

In the Survey, the most commonly used form of analgesia was self-administered nitrous oxide and air (53.5 percent), which was associated with a perinatal mortality 36 percent below average. However, this combination was most commonly used in home delivery and therefore with a selected group, so it is not possible to evaluate its safety from these data. At present, nitrous oxide and oxygen is gradually replacing nitrous oxide and air, because of the possibility of serious hypoxia when equal amounts of nitrous oxide and air are used.

Self-administered trilene was much less frequently used (22.6 percent), and its use was associated with a perinatal mortality only just below average. However, it was used more frequently in hospital deliveries, especially when maternal hypertension was present. Combinations of nitrous oxide, oxygen, and trilene were rarely used. One in five women received no volatile analgesics, for reasons ranging from rejection by the patient to lack of time or lack of availability.

The most commonly used analgesic drug administered in the last 12 hours of labor was pethidine (meperidine). In the last 12 hours of labor, 54.5 percent of all women received intramuscular pethidine with a perinatal mortality well below average. The administration of these physiological doses of pethidine appeared not to contribute to deaths which occurred immediately after birth from a combination of anoxia and respiratory depression. The use of morphia was virtually confined to cases of very pre-

mature labor or accidental hemorrhage and was therefore naturally associated with a very high perinatal mortality.

The administration of pethidine, nitrous oxide and air, and trilene in this country is for the most part the responsibility of the midwife supervising the delivery. These methods of analgesia seem to be reasonably safe as far as the fetus is concerned.

Method of Delivery

Spontaneous vertex delivery occurred in 87.8 percent of all single pregnancies in the Survey (table 24). Forceps delivery by the vertex occurred in 4.7 percent of all deliveries. Four-fifths of the forceps deliveries took place in hospitals; one in five was performed by a family doctor, either in the home or in a general practitioner maternity unit. Breech delivery occurred in 2.2 percent of all cases. One-third of breech deliveries were conducted by midwives, 1 in 10 by family doctors, and the remainder by obstetricians. Cesarean section was required for 2.7 percent of women. Delivery was unattended in 2.1 percent of the pregnancies.

Episiotomy was performed in one-third of primiparae and in about 6 percent of multiparae. Episiotomy has the advantages of shortening the second stage of labor and minimizing damage to the pelvic floor and is widely recommended by obstetricians in this country. Episiotomy was used more frequently in hospital deliveries and less frequently in the home, because of the difficulties of perineal repair in the home. The decision to perform an episiotomy is generally taken by the midwife, but lacerations and episiotomies must be repaired by doctors.

Perinatal mortality was at its lowest in babies delivering by the vertex, with a slight increase in mortality when the occiput was posterior. Perinatal mortality was also lowest in low birth weight babies delivering spontaneously by the vertex (table 24). Forceps delivery was associated with a considerable increase in mortality, almost entirely due to an increase in the number of deaths from intrapartum anoxia and/or trauma. This is related to the indications for forceps delivery, since fetal distress was present in over one-third of the cases. In general, forceps are not used in Britain except in the presence of a specific indication for assisted delivery.

Breech delivery was associated with a very high perinatal mortality. This was partly due to a large number of antepartum stillbirths and congenital malformations which were delivered by the breech. However, perinatal deaths from intrapartum anoxia and/or trauma and early neonatal death from "respiratory distress syndrome" were also very frequent after breech delivery. This was mostly due to the greater frequency of breech deliveries at low gestation. "Respiratory distress syndrome" was three times more frequent in breech deliveries weighing 2,500 grams or less than in vertex deliveries of the same weight. However, breech delivery becomes progressively more frequent as the birth weight falls. It is, therefore, not possible to conclude that hypoxia associated with preterm breech delivery was a precipitating factor in the development of atelectasis with hyaline membranes.

Cesarean section was associated with an increased perinatal mortality rate because of the indications for the operation. Death from intrapartum anoxia and/or trauma and early neonatal death from "respiratory distress syndrome" were the main causes. The mean birth weight of babies dying from hyaline membrane disease after delivery by cesarean section was significantly higher than that of babies dying of hyaline membrane disease after vaginal or breech delivery. Of the deaths due to hyaline membrane disease after cesarean section, 25 percent weighed more than 2,500 grams compared with 12 percent of deaths from hyaline membrane disease after delivery by other routes. Early neonatal death from "respiratory distress syndrome" in babies weighing 2,500 grams or less was four times more common after delivery by cesarean section than after vaginal delivery. These facts are in agreement with the suggestion that delivery by cesarean section predisposes to the development of the "respiratory distress syndrome."[48] However, these figures have not been adjusted for differences in the incidence of antepartum hemorrhage, or other emergencies leading to delivery by cesarean section.

The predominant indications for cesarean section are shown in table M, together with perinatal mortality of cesarean sections. Mortality was lowest in sections for delay or disproportion in labor and was highest in association with placenta previa and severe hypertension. These differences are, of course, associated with large differences in gestation. More than half the cesarean sections were performed by consultant obstetricians and 97 percent took place in obstetric hospitals.

Anesthesia for Operative Delivery

General anesthesia was used for 95 percent of the mothers in the Survey who were delivered by cesarean section; regional or spinal anesthesia was rarely used. It was not possible to compare anesthetics in relation to perinatal mortality since the prime determinants of mortality are the length of gestation and the indications for cesarean section.

Forceps delivery was conducted under a general anesthetic in 59 percent of cases. Pudendal block was the commonest form of local anesthesia but was rarely used by the general practitioner. Greater use of pudendal block outside obstetric hospitals is indicated.

Breech delivery was conducted without anesthesia in 58 percent of the cases. General anesthesia was used in 17 percent of breech deliveries and local anesthesia for the remainder. Once again the safe pudendal block was rarely used by the general practitioner delivering babies either at home or in the general practitioner maternity unit.

Complications of Labor

Malpresentations other than breech were rare in the Survey. Face, brow, or shoulder occurred in only 0.7 percent of all deliveries. Internal version for shoulder presentation was rarely used, but 30 percent of the infants thus presenting died during the perinatal period.

The incidence of various types of fetal distress in all births during the control week of the Survey is presented in table N. Fetal bradycardia (under 120 beats per minute) or tachycardia (over 160 beats per minute) was the most frequently detected sign of fetal distress and also the one with the lowest mortality. These figures do not suggest that the passage of meconium without alteration in the fetal heart can be safely ignored.

Table M. Percentage distribution of cesarean sections and stillbirth and neonatal mortality rates, by indication for section: England, Scotland, and Wales, 1958

[Includes total single births for control week, March 3-9, 1958. Stillbirths and neonatal deaths for March-May 1958 are related to estimated births for the same months]

Indication for cesarean section	Percentage distribution	Stillbirth and neonatal deaths per 100 total births
Total cesarean sections	100	6.2
Elective section at term	32	2.5
Fetal distress	18	5.9
Delay in labor	17	1.4
Placenta previa	13	10.5
Severe hypertension	6	39.0
Disproportion in labor	4	0.9
Other conditions	10	-

Table N. Percent of deliveries and stillbirth and neonatal mortality rates, by specified sign of fetal distress: England, Scotland, and Wales, 1958

[Includes total single births for control week, March 3-9, 1958. Stillbirths and neonatal deaths for March-May 1958 are related to estimated births for the same months. Excludes macerated stillbirths and deaths from congenital malformations]

Sign of fetal distress	Percent of deliveries	Stillbirths and neonatal deaths per 100 total births
Prolapse or presentation of cord	0.3	34.0
Passage of meconium	0.9	5.5
Fetal bradycardia or tachycardia	2.0	4.9
Passage of meconium with fetal bradycardia or tachycardia	0.7	6.9

Multiple Pregnancy

During the control week of the Survey, 1.2 percent of all pregnancies were multiple. Separation into monozygotic and dizygotic twins was not possible in this series. The perinatal mortality of single births, of the first twin (twin I), and of the second twin (twin II) are shown in table 25. The combined mortality of twins exceeded 25 percent. Multiple pregnancy was associated with a much higher incidence of early delivery and low birth weight than was single delivery.

Comparisons of perinatal mortality in twin I and twin II reveal some interesting differences. Mortality from intrapartum anoxia and/or trauma was nearly twice as high in twin II, as also was the rate of early neonatal death from "respiratory distress syndrome." These differences lend some support to the hypothesis that intrapartum hypoxia predisposes to the development of respiratory distress in the prematurely born infant. Death from pulmonary infection, on the other hand, was more common in twin I. This lends indirect support to the hypothesis of a relationship between prolonged rupture of the membranes and postnatal pneumonia. A higher incidence of chorionitis in the placenta in twin I has been reported. Massive pulmonary hemorrhage (included in the "other" group) was eight times more frequent in twins than in single births. This is further confirmation of an association of twin pregnancy with intrauterine growth retardation.

Improvement in the very poor results for multiple pregnancies is obviously urgent. Most of these multiple pregnancies were in fact diagnosed before the onset of labor, but prenatal rest in the last trimester, which is considered desirable by some in this country,[49] was by no means the rule. However, the Survey series was not large enough to assess the effect of bed rest between 30 and 36 weeks on the outcome of twin pregnancy. The large differences in mortality between twins I and II suggest that the delivery of the second twin could be improved. Clearly the whole obstetric care of a twin pregnancy should be the responsibility of an experienced obstetrician, and especially the delivery of the second twin.

The mortality in multiple pregnancy was at its lowest in babies delivered just before term. Prolongation of pregnancy 7 days beyond term was associated with a two-fold increase in perinatal mortality. This is in accordance with the conclusion of Brown and Dixon that the pregnancies of women bearing twins should not be allowed past term.[49]

PROPHYLACTIC IMMUNIZATION IN INFANCY

Diphtheria

No deaths from diphtheria were reported in the first year of life (or at any age) in 1965 and in the same year there were only 25 notifications of this disease at any age. These rates and those in the remainder of this section apply to England and Wales. Average annual notifications at all ages from 1933-42 had totaled 55,125 cases, with 2,783 deaths. Immunization with diphtheria toxoid was introduced in certain areas during the 1930's and extended as a nationwide program in 1942. It is now given mainly in the first year of life as part of primary immunization with DTP vaccine (triple prophylactic against diphtheria, tetanus, and pertussis).

Pertussis

Infant deaths from whooping cough in 1965 numbered 15 out of a total at all ages of 21 deaths. This emphasizes that the major risk for this infection, though now slight, is mainly to young infants. Yearly notifications at all ages averaged around 90,000 for the period 1954-57, with an annual average of 101 deaths, of which an average of 71 deaths took place in infants under 1 year of age. After the advent of widespread whooping cough immunization in the late 1950's the average annual notifications between 1963 and 1965 had dropped to 26,400, of which approximately 10 percent were under 1 year. Whooping cough immunization is given as early as possible in the first year of life, usually as part of a course of DTP vaccine (triple prophylactic).

Tetanus

In 1965, 21 deaths from tetanus were registered, none of which were under the age of 1 year. A full course of immunization with tetanus toxoid is encouraged in infancy again as part of course of DTP vaccine. Administration of a full course of tetanus toxoid renders unnecessary the prophylactic use of tetanus antitoxin (horse), which produces each year in Britain dangerous hypersensitivity reactions in susceptible individuals. Half the cases of clinical tetanus in Britain give no history or evidence of an entry wound.

Poliomyelitis

There were no infant deaths from poliomyelitis reported in 1965. Only 3 fatalities from acute poliomyelitis were recorded at all ages during that year, together with 16 deaths from late effects of poliomyelitis. In the years 1953 to 1955, before poliomyelitis immunization was introduced, the average yearly poliomyelitis notifications were 4,279, with an average of 247 deaths. This fell by 1963-65 to an annual average of 60 notifications with an average of 29 deaths, of which 25 were due to late effects. The first year of life is considered the optimum time for producing active primary immunity against poliomyelitis. The oral attenuated Sabin trivalent vaccine was introduced officially in 1962 and is preferred to Salk-type killed polio-vaccine.

Smallpox

In Great Britain, routine smallpox vaccination is no longer compulsory. Smallpox vaccination has recently come under criticism in view of the rarity of the disease and the possibility of severe vaccination reactions.[50] Nevertheless, smallpox vaccination still has a prominent place in the official childhood immunization program, as it is considered that this diminishes the hazards which would accompany primary vaccination if postponed until later in life. Moreover, a highly protected community is thought to provide a reservoir of immunity which may limit the spread of smallpox during occasional epidemics. The modified variola virus-vaccine, treated with glycerol and phenol, presently in use, is known to carry a small though definite risk of provoking generalized vaccinia, vaccinal encephalopathy, or eczema vaccinatum. Wynne-Griffith[51] has studied the reported cases of postvaccinal encephalopathy and of generalized vaccinia reported after primary vaccination in England and Wales between 1951 and 1957. The incidence of vaccinal encephalopathy was highest during the first year of life (15.8 per million with a mortality of 8.7 per million); it was lowest in the age group 1 to 4 years (2.1 per million with no deaths) and rose

again over 15 years of age (28.7 per million with 2.9 deaths per million). A similar pattern was evident for generalized vaccinia. It has, therefore, been recommended that routine smallpox vaccination in the United Kingdom be postponed until the second year of life. As a result, in 1965 only 33 percent of children under 2 years of age received primary vaccination and vaccination figures are low at all ages.

Measles

The justification for protection against measles in economically advanced countries like Britain lies not in the mortality risk but in the high prevalence and high morbidity rate of the disease during childhood. Though both killed and living (attenuated) measles vaccines have been officially available since 1965 for doctors wishing to use them, this has not been followed by a national campaign for mass measles vaccination, mainly because of uncertainty about the duration of immunity and a possibility of increased adult susceptibility. A simple and effective regime consists of a single intramuscular dose of attenuated vaccine, given from the age of 9 months upward, but pyrexia or rash are occasionally troublesome though harmless complications. Measures employed to reduce such reactions include further attenuation, simultaneous administration of gamma globulin, or the prior injection of one or two doses of killed vaccine before administration of the attenuated vaccine.

Tuberculosis

BCG vaccination of tuberculin-negative subjects with freeze-dried vaccine is offered routinely to children in England and Wales prior to leaving school. For infants and young children, this measure is at present reserved for tuberculous contacts or other at-risk groups. Widespread BCG vaccination of the newborn, as in Scotland, is thought desirable by some.

Immunization Schedules

Recommended immunization schedules in the United Kingdom are designed with five main objectives. These are to provide the highest protection against each disease, to cover the age of greatest risk, to give minimal reaction rates, to ensure the fewest number of visits, and thus to enable maximal acceptance rate. The immunizations are given either by the family doctor or at the local authority clinic. In most areas it is considered preferable to complete the primary immunization course against diphtheria, tetanus, and pertussis, using triple prophylactic (DTP vaccine), within the first 6-9 months of life. Oral trivalent poliovaccine (OPV) can be given at the same visits as DTP vaccine. The youngest age at which effective primary immunity can be established depends mainly on the level of inherited maternal antibody. High levels may blanket the effect of active immunization in the early months of life. This is particularly important when weak antigens are favored, as in the United Kingdom where plain vaccines and fluid toxoids are used. It is partly for this reason that two alternative immunization schedules are permitted by the Ministry of Health.[52] In the first, a primary course of DTP vaccine is given at 3, 4, and 5 months of age. Three doses of trivalent OPV are given between 7 and 11 months of age. Six visits are thus necessary in the first year of life. These six visits can be cut to three if the OPV is given simultaneously with the injection of DTP vaccine.[53] However the primary course of DTP vaccine which is used currently in the United Kingdom in plain (nonadsorbed) form, is often started at 1 to 2 months of age, as the injection of killed pertussis organisms enhances the antigenic effect of fluid diphtheria toxoid. In such cases, a fourth reinforcing dose must be given during the second year of life.

The alternative immunization scheme recommended officially in the United Kingdom is based on the fact that insufficient lasting active immunity may be produced when antigens are given before 6 months of age. In this schedule, trivalent OPV is fed between 6 and 10 months at monthly intervals for three doses. This is followed by two injections of plain DTP vaccine at monthly intervals between 11 and 13 months of age. This is an effective regime, but disadvantages include the number of visits and the limited value in reducing the peak mortality or morbidity of pertussis, which occurs in the first year of life. It is therefore not very popular.

OUTLOOK FOR THE FUTURE

Perinatal death has declined slowly but steadily over the past 35 years chiefly because of the application of principles based on empiricism, rather than on etiology. Until research throws light on the causation or control of congenital malformation, premature delivery, and preeclamptic toxemia, there is little prospect of dramatic change, but the empirical approach can still be expected to bring considerable improvement.

Apart from congenital malformations the problem of perinatal death is almost wholly obstetric. Whether it is viewed as the safeguarding of high-risk groups or as the prevention of deaths from anoxia, trauma, and respiratory failure, the most important factors are the experience, skill, and judgment of the professional attendant. Consequently, medical teaching and government policy are based on the need to ensure that the groups of mothers whose offspring are known to have a higher than average risk of perinatal mortality come under the supervision of obstetric specialists throughout pregnancy and childbirth. Such mothers should be booked for confinement in hospital, which presumes a sufficiency of maternity beds and the cooperation of family doctors, midwives, and the mothers themselves. For the country as a whole, sufficient beds are not yet available because the sudden and partly unpredicted rise of the birth rate from 1955 to 1964 outran the increasing provision of maternity units. Consequently, earlier discharge from hospital has become expedient in many areas until additional maternity beds become available. Meanwhile, careful selection for consultant care in hospital is not yet fully carried out. Perinatal mortality may be expected to continue improving as selection improves and as more beds become available in maternity units under consultant supervision.

After the perinatal period, the prevention of mortality becomes much less empirical. Some part of neonatal mortality has the same background as perinatal mortality; death from congenital malformations remains intractable and the control of viral infection is still in the future. But, in general, as the infant grows older etiology is clearer and mortality controllable. It is not a question, as in the perinatal period, of attempting to minimize risks but of preventing the preventable. The number of failures is small and postneonatal death is uncommon. Because these deaths are relatively few the technique of individual confidential investigation, which proved successful in maternal mortality, can be and is being used for postneonatal death. By this means avoidable factors that may have contributed to a death can be identified. They may be of local or national significance and may indicate a need for action to ensure that the medicosocial services and the full range of preventive and curative medical care are available, are known to be available, and are used.

Congenital malformation remains the one cause of perinatal and infant mortality for which there seems scant chance of improvement in the foreseeable future, despite the advances in genetics. Surgery seems unlikely to effect more than slight improvement. Since man has begun to add to his environment teratogenic agents that he cannot fully control, the epidemiology of congenital malformation has become of prime importance, but with a view to safeguarding against increase, rather than promising decrease. As other causes of infant mortality steadily decline, congenital malformation still remains an intractable problem in western countries.

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DETAILED TABLES

Table 1. Number and rates for live births, perinatal deaths, stillbirths, and infant and maternal deaths: England and Wales, 1901-63

Year	Live births[1]		Perinatal deaths		Stillbirths[1]		Infant deaths		Maternal deaths	
	Number	Rate per 1,000 population	Number	Rate per 1,000 total births	Number	Rate per 1,000 total births	Number	Rate per 1,000 live births[2]	Number	Rate per 1,000 total births
1963	856,232	18.2	25,498	29.3	15,000	17.2	18,042	21.1	243	0.3
1962	838,736	18.0	26,352	30.8	15,464	18.1	18,187	21.7	299	0.4
1961	811,281	17.6	26,495	32.0	15,727	19.0	17,393	21.4	274	0.3
1960	785,005	17.2	26,294	32.8	15,819	19.8	17,118	21.8	310	0.4
1959	748,501	16.5	26,070	34.1	15,901	20.8	16,629	22.2	290	0.4
1958	740,715	16.4	26,502	35.0	16,288	21.5	16,685	22.5	328	0.4
1957	723,331	16.1	26,792	36.2	16,615	22.5	16,720	23.1	333	0.5
1956	700,335	15.6	26,334	36.7	16,405	22.9	16,554	23.7	374	0.5
1955	667,811	15.0	25,579	37.4	15,829	23.2	16,613	24.9	405	0.6
1954	673,651	15.1	26,248	38.1	16,200	23.5	17,160	25.4	446	0.7
1953	684,372	15.4	25,808	36.9	15,681	22.4	18,324	26.8	495	0.7
1952	673,735	15.3	25,834	37.5	15,636	22.7	18,555	27.6	463	0.7
1951	677,529	15.4	26,487	38.2	15,985	23.0	20,223	29.7	526	0.8
1950	697,097	15.8	26,690	37.4	16,084	22.6	20,817	29.6	620	0.9
1949	730,518	16.9	28,369	38.0	16,947	22.7	23,882	32.4	727	1.0
1948	775,306	18.1	30,546	38.5	18,399	23.2	26,766	33.9	811	1.0
1947	881,026	21.1	36,428	40.3	21,795	24.1	36,849	41.4	1,060	1.2
1946	820,719	20.2	37,369	44.3	22,915	27.2	33,541	42.9	1,209	1.4
1945	679,937	17.9	31,639	45.2	19,333	27.6	31,959	46.0	1,260	1.8
1944	751,478	19.9	34,404	44.5	21,306	27.6	33,455	45.4	1,492	1.9
1943	684,334	18.1	33,785	47.9	21,262	30.1	33,431	49.1	1,620	2.3
1942	651,503	17.0	35,081	52.1	22,383	33.2	32,258	50.6	1,672	2.5
1941	579,091	14.9	32,829	54.7	20,876	34.8	34,550	60.0	1,678	2.8
1940	590,120	14.8	35,390	57.7	22,779	37.2	33,892	56.8	1,641	2.7
1939	614,479	14.9	37,390	58.5	24,320	38.1	31,190	50.6	1,997	3.1
1938	621,204	15.1	37,835	58.6	24,729	38.3	32,724	52.8	2,096	3.2
1937	610,557	14.9	38,252	60.2	24,806	39.0	35,175	57.7	2,142	3.4
1936	605,292	14.8	38,300	60.8	25,045	39.7	35,425	58.7	2,431	3.9
1935	598,756	14.7	38,618	61.9	25,435	40.7	34,092	57.0	2,590	4.2
1934	597,642	14.8	38,733	62.2	25,209	40.5	35,017	59.3	2,880	4.6
1933	580,413	14.4	38,388	63.4	25,084	41.4	36,960	62.7	2,737	4.5
1932	613,972	15.3	40,244	62.8	26,471	41.3	39,933	64.5	2,683	4.2
1931	632,081	15.8	40,914	62.1	26,933	40.9	41,939	65.7	2,706	4.1
1930	648,811	16.3	41,844	61.9	27,577	40.8	38,908	60.2	2,855	4.2
1926-30	3,301,486	16.7	---	---	---	---	224,103	67.6	14,111	4.3
1921-25	3,827,584	19.9	---	---	---	---	291,082	74.9	14,932	3.9
1916-20	3,766,747	21.5	---	---	---	---	338,782	90.9	15,518	4.1
1911-15	4,329,475	23.9	---	---	---	---	474,338	108.7	17,453	4.0
1906-10	4,604,940	26.3	---	---	---	---	539,136	117.1	17,208	3.7
1901-5	4,693,269	28.2	---	---	---	---	646,845	137.8	20,028	4.3

[1]Prior to 1939, births were allocated to the year of registration; beginning with 1939, to the year of birth.

[2]For 1901-25, infant mortality rates are based on births registered in the year specified. For 1926-56, rates are based on related live births, i.e., births during the associated and preceding year to which the infant deaths relate. For 1957-63, rates are based on live births occurring in the year specified.

Table 2. Infant mortality rates, by age: England and Wales, 1930-63

Year	Under 7 days	Under 1 day	1-6 days	7-27 days	28 days-5 months	6-11 months
	Rate per 1,000 live births[1]					
1963	12.3	7.2	5.1	2.0	5.1	1.8
1962	13.0	7.4	5.6	2.1	4.8	1.8
1961	13.3	7.6	5.7	2.1	4.4	1.7
1960	13.3	7.5	5.8	2.2	4.6	1.6
1959	13.6	7.6	6.0	2.3	4.5	1.8
1958	13.8	7.5	6.3	2.4	4.6	1.7
1957	14.1	7.6	6.5	2.4	4.8	1.9
1956	14.2	7.4	6.8	2.6	5.0	1.8
1955	14.6	7.6	7.0	2.6	5.5	2.1
1954	14.9	7.6	7.4	2.8	5.6	2.1
1953	14.8	7.4	7.4	2.9	6.4	2.7
1952	15.2	7.6	7.6	3.2	6.7	2.6
1951	15.5	7.5	8.0	3.3	7.7	3.2
1950	15.2	7.2	8.0	3.3	8.0	3.1
1949	15.6	7.6	8.0	3.7	9.2	3.8
1948	15.6	7.8	7.9	4.1	10.3	3.9
1947	16.5	7.8	8.7	6.2	12.9	5.7
1946	17.8	8.7	9.1	6.7	13.2	5.2
1945	18.0	9.0	9.0	6.8	15.2	6.1
1944	17.5	8.8	8.8	6.9	15.0	6.1
1943	18.3	9.1	9.2	6.9	16.6	7.3
1942	19.6	9.6	10.0	7.7	16.2	7.2
1941	20.7	10.1	10.6	8.3	21.0	10.1
1940	21.3	9.8	11.5	8.3	17.5	9.7
1939	21.2	10.3	10.9	7.1	14.9	7.3
1938	21.1	10.3	10.8	7.1	15.5	9.0
1937	22.0	10.8	11.2	7.8	17.7	10.3
1936	21.9	10.7	11.3	8.2	17.6	10.9
1935	22.0	10.7	11.3	8.4	16.8	9.8
1934	22.7	10.9	11.8	8.7	16.6	11.3
1933	22.9	11.0	11.8	9.3	18.4	12.2
1932	22.4	10.6	11.8	9.2	19.8	13.2
1931	22.1	10.4	11.7	9.5	20.0	14.2
1930	22.0	10.4	11.6	8.9	17.6	11.7

[1]For 1930-56, rates are based on related live births. For 1957-63, rates are based on live births occurring in the year specified.

Table 3. Infant mortality rates, by sex and age: England and Wales, 1930-63

Year	Male						Female					
	Under 7 days	Under 1 day	1-6 days	7-27 days	28 days-5 months	6-11 months	Under 7 days	Under 1 day	1-6 days	7-27 days	28 days-5 months	6-11 months
	Rate per 1,000 live births[1]											
1963	14.0	8.0	6.0	2.1	5.7	1.9	10.4	6.4	4.0	1.8	4.5	1.7
1962	14.9	8.4	6.5	2.3	5.4	1.8	10.9	6.3	4.6	1.9	4.2	1.7
1961	15.1	8.5	6.6	2.2	4.8	1.7	11.3	6.6	4.6	1.9	4.0	1.7
1960	15.4	8.5	6.8	2.4	5.0	1.7	11.2	6.5	4.7	2.0	4.2	1.5
1959	15.3	8.2	7.1	2.4	5.0	1.9	11.8	6.9	4.9	2.2	4.1	1.7
1958	15.7	8.4	7.3	2.6	5.1	1.9	11.7	6.5	5.2	2.1	4.2	1.6
1957	16.2	8.5	7.6	2.5	5.1	2.0	11.8	6.6	5.2	2.3	4.4	1.8
1956	16.3	8.3	8.0	2.9	5.7	1.9	11.9	6.3	5.6	2.4	4.4	1.6
1955	16.7	8.5	8.2	2.8	6.1	2.4	12.4	6.6	5.7	2.5	4.8	1.9
1954	17.1	8.3	8.8	3.1	6.2	2.3	12.6	6.8	5.8	2.5	5.0	1.9
1953	16.8	8.1	8.6	3.1	7.0	2.9	12.7	6.7	6.0	2.6	5.8	2.4
1952	17.2	8.3	8.9	3.4	7.4	2.8	12.9	6.8	6.2	2.9	5.7	2.5
1951	18.0	8.5	9.5	3.6	8.6	3.5	12.9	6.5	6.4	3.1	6.8	3.0
1950	17.5	8.1	9.4	3.7	9.0	3.4	12.8	6.3	6.5	2.9	7.2	3.0
1949	17.9	8.7	9.2	4.0	10.6	4.4	13.3	6.6	6.7	3.3	8.0	3.7
1948	17.8	8.9	8.9	4.4	11.8	4.6	13.4	6.6	6.8	3.7	9.0	4.0
1947	18.6	8.8	9.8	6.9	15.0	6.2	14.5	6.9	7.6	5.5	11.4	5.2
1946	20.1	9.8	10.3	7.4	13.8	4.8	15.0	7.4	7.6	5.8	10.6	4.0
1945	20.3	9.9	10.4	7.5	17.5	7.2	15.7	8.2	7.6	6.0	13.5	5.9
1944	19.3	9.5	9.8	7.6	16.6	6.0	15.5	7.9	7.6	6.0	12.5	5.3
1943	20.4	9.9	10.5	7.5	18.9	7.7	16.1	8.2	7.9	6.3	14.1	6.5
1942	21.9	10.6	11.3	8.3	18.0	7.1	16.9	8.4	8.5	6.9	13.5	6.0
1941	23.5	11.0	12.4	9.1	23.5	10.9	17.7	9.0	8.7	7.4	17.6	9.2
1940	24.3	10.8	13.5	9.0	20.7	11.1	18.3	8.7	9.5	7.6	14.6	8.9
1939	23.7	11.2	12.4	7.7	17.2	8.1	18.7	9.4	9.4	6.4	12.8	6.7
1938	23.8	11.4	12.4	8.0	17.8	9.9	18.3	9.0	9.3	6.4	12.8	8.1
1937	24.4	11.8	12.5	8.5	20.4	11.4	19.5	9.7	9.8	7.0	14.6	9.0
1936	24.8	11.9	12.9	9.3	20.2	11.9	18.8	9.3	9.5	7.1	13.7	9.7
1935	24.9	12.0	12.9	9.3	19.1	10.7	19.0	9.5	9.5	7.5	14.4	8.7
1934	25.6	12.1	13.6	9.6	18.4	11.8	19.5	9.7	9.8	7.8	14.2	10.0
1933	25.9	12.2	13.7	10.4	21.5	14.1	19.8	9.9	9.9	8.2	15.8	11.4
1932	25.8	11.9	13.9	10.2	22.6	14.8	18.9	9.3	9.6	8.1	17.2	12.1
1931	25.1	11.6	13.5	10.7	23.4	16.0	19.0	9.1	9.9	8.2	16.8	13.0
1930	25.0	11.7	13.3	10.2	20.3	12.7	18.9	9.1	9.8	7.6	14.5	10.4

[1]For 1930-38, rates are based on births registered in the year specified; for 1939-63, rates are based on births occurring in the year specified.

Table 4. Average annual infant mortality rates, by age, sex, and cause of death: England and Wales, 1950-52

Cause of death Sixth Revision of International Lists, 1948	Under 1 year	Under 7 days	Under 1 day	1-6 days	7-27 days	28 days-5 months	6-11 months
	Rate per 100,000 live births						
Both sexes							
All causes	2,909	1,528	743	786	329	749	304
Influenza---480-483	13	0	-	0	1	8	4
Pneumonia---490-493,763	476	55	4	51	77	252	93
Bronchitis---500-502	64	1	0	1	3	43	16
Other respiratory diseases---470-475,510-527	16	1	0	1	2	9	3
Gastritis and duodenitis---543	3	0	-	0	0	1	1
Gastroenteritis---571,764	130	1	0	1	12	86	32
Spina bifida and meningocele---751	91	30	10	20	32	23	6
Congenital hydrocephalus---752	48	17	8	9	11	13	6
Congenital malformations of heart---754.0-754.5	150	61	16	45	26	47	16
Congenital malformations of genitourinary system---757	15	5	3	2	3	5	1
Other congenital malformations---Remainder of 750-759	134	66	27	40	24	35	9
Birth injury---760,761	270	248	122	126	17	4	1
Postnatal asphyxia and atelectasis---762	339	308	161	148	21	8	1
Pemphigus and sepsis of newborn---766-768	10	2	0	2	6	1	0
Hemolytic disease of newborn---770	70	60	21	40	7	2	1
Immaturity---774,776	570	512	293	220	43	14	0
Accidental suffocation---E921-E925	82	4	1	3	7	61	10
Lack of care of infant---E926	14	14	13	0	0	0	0
Other accidents---Remainder of E800-E999	13	3	3	0	1	5	5
All other causes---Residual	401	140	61	77	36	132	99
Male							
All causes	3,275	1,757	830	927	359	836	324
Influenza---480-483	17	0	-	0	1	11	5
Pneumonia---490-493,763	526	66	4	61	88	276	97
Bronchitis---500-502	72	1	0	1	3	51	17
Other respiratory diseases---470-475,510-527	17	1	1	1	2	10	3
Gastritis and duodenitis---543	3	0	-	0	1	2	0
Gastroenteritis---571,764	153	1	0	1	14	100	38
Spina bifida and meningocele---751	74	24	6	18	26	19	5
Congenital hydrocephalus---752	42	15	7	9	9	13	5
Congenital malformations of heart---754.0-754.5	166	74	18	56	27	49	16
Congenital malformations of genitourinary system---757	22	8	5	3	4	9	2
Other congenital malformations---Remainder of 750-759	151	67	25	42	28	46	9
Birth injury---760,761	334	309	144	165	20	4	1
Postnatal asphyxia and atelectasis---762	399	365	185	180	24	9	1
Pemphigus and sepsis of newborn---766-768	12	3	0	3	7	2	0
Hemolytic disease of newborn---770	80	68	19	49	8	3	1
Immaturity---774,776	637	577	333	244	46	14	0
Accidental suffocation---E921-E925	94	4	1	3	8	70	11
Lack of care of infant---E926	16	15	15	0	0	0	0
Other accidents---Remainder of E800-E999	15	3	3	0	1	6	5
All other causes---Residual	445	156	64	91	42	142	108
Female							
All causes	2,522	1,287	650	636	296	657	282
Influenza---480-483	10	0	-	0	1	6	3
Pneumonia---490-493,763	423	44	4	40	65	226	88
Bronchitis---500-502	55	1	-	1	3	35	15
Other respiratory diseases---470-475,510-527	14	1	0	1	2	8	4
Gastritis and duodenitis---543	2	0	-	0	0	1	1
Gastroenteritis---571,764	106	0	0	0	9	71	26
Spina bifida and meningocele---751	109	35	13	22	38	28	8
Congenital hydrocephalus---752	53	19	9	10	14	14	6
Congenital malformations of heart---754.0-754.5	133	48	15	33	25	45	15
Congenital malformations of genitourinary system---757	7	3	2	2	2	2	0
Other congenital malformations---Remainder of 750-759	116	65	28	37	18	23	9
Birth injury---760,761	201	184	99	85	14	3	0
Postnatal asphyxia and atelectasis---762	275	248	135	113	19	7	1
Pemphigus and sepsis of newborn---766-768	8	2	-	2	5	1	0
Hemolytic disease of newborn---770	60	52	23	30	5	2	1
Immaturity---774,776	499	444	251	194	40	14	-
Accidental suffocation---E921-E925	69	3	1	2	6	52	8
Lack of care of infant---E926	13	12	11	1	-	1	0
Other accidents---Remainder of E800-E999	11	3	2	1	0	4	4
All other causes---Residual	358	123	57	62	30	114	93

NOTE: Rates based upon less than an annual average of 20 deaths are underscored as a warning to users that the smallness of the experience may affect their significance.

Table 5. Average annual infant mortality rates, by age, sex, and cause of death: England and Wales, 1959-61

Cause of death Sixth Revision of International Lists, 1948	Under 1 year	Under 7 days	Under 1 day	1-6 days	7-27 days	28 days-5 months	6-11 months
Both sexes	Rate per 100,000 live births						
All causes	2,181	1,340	758	582	218	453	170
Influenza---480-483	6	0	-	0	1	3	2
Pneumonia---490-493,763	296	51	8	43	42	153	50
Bronchitis---500-502	46	1	0	1	2	32	11
Other respiratory diseases---470-475,510-527	12	2	1	1	1	7	3
Gastritis and duodenitis---543	0	0	-	0	0	0	0
Gastroenteritis---571,764	44	1	-	1	6	24	14
Spina bifida and meningocele---751	82	21	8	13	29	26	7
Congenital hydrocephalus---752	56	18	10	8	10	19	9
Congenital malformations of heart---754.0-754.5	151	56	13	43	29	51	15
Congenital malformations of genitourinary system--757	18	9	7	2	4	4	1
Other congenital malformations---Remainder of 750-759	143	84	44	40	24	27	7
Birth injury---760,761	244	233	130	104	10	0	-
Postnatal asphyxia and atelectasis---762	343	332	201	131	8	3	0
Pemphigus and sepsis of newborn---766-768	8	2	0	2	5	1	0
Hemolytic disease of newborn---770	46	42	29	13	2	1	0
Immaturity---774,776	383	363	247	116	15	4	-
Accidental suffocation---E921-E925	42	1	0	1	4	30	7
Lack of care of infant---E926	6	6	5	0	0	0	0
Other accidents---Remainder of E800-E999	14	2	2	0	1	5	6
All other causes---Residual	241	116	53	63	25	63	38
Male							
All causes	2,431	1,526	843	683	235	493	177
Influenza---480-483	6	0	-	0	1	3	2
Pneumonia---490-493,763	332	62	8	54	47	167	56
Bronchitis---500-502	51	1	0	1	2	35	12
Other respiratory diseases---470-475,510-527	13	2	1	1	1	8	2
Gastritis and duodenitis---543	0	0	-	0	0	0	-
Gastroenteritis---571,764	50	1	-	1	7	28	14
Spina bifida and meningocele---751	67	17	6	11	24	21	5
Congenital hydrocephalus---752	50	16	9	6	9	17	8
Congenital malformations of heart---754.0-754.5	161	65	12	52	29	55	13
Congenital malformations of genitourinary system--757	25	12	9	3	6	6	1
Other congenital malformations---Remainder of 750-759	147	82	40	42	27	30	7
Birth injury---760,761	300	287	154	133	13	0	-
Postnatal asphyxia and atelectasis---762	401	389	227	162	9	3	0
Pemphigus and sepsis of newborn---766-768	10	3	0	2	6	1	0
Hemolytic disease of newborn---770	46	42	28	14	3	1	0
Immaturity---774,776	423	403	282	121	15	4	-
Accidental suffocation---E921-E925	48	2	0	1	4	35	8
Lack of care of infant---E926	6	6	6	0	0	0	-
Other accidents---Remainder of E800-E999	15	2	2	0	1	6	6
All other causes---Residual	280	134	59	79	31	73	43
Female							
All causes	1,916	1,142	668	474	200	410	163
Influenza---480-483	5	0	-	0	0	3	2
Pneumonia---490-493,763	257	40	9	30	36	138	44
Bronchitis---500-502	40	1	0	1	2	28	10
Other respiratory diseases---470-475,510-527	11	2	1	1	1	5	3
Gastritis and duodenitis---543	0	0	-	0	0	0	0
Gastroenteritis---571,764	38	1	-	1	4	20	13
Spina bifida and meningocele---751	99	26	10	16	34	31	8
Congenital hydrocephalus---752	63	21	11	10	11	21	10
Congenital malformations of heart---754.0-754.5	140	46	14	33	28	48	18
Congenital malformations of genitourinary system--757	10	6	4	1	2	2	1
Other congenital malformations---Remainder of 750-759	138	85	48	37	21	25	8
Birth injury---760,761	184	176	104	72	8	0	-
Postnatal asphyxia and atelectasis---762	280	271	173	98	6	3	0
Pemphigus and sepsis of newborn---766-768	7	2	0	2	4	1	-
Hemolytic disease of newborn---770	45	42	30	12	2	1	0
Immaturity---774,776	340	321	211	111	15	4	-
Accidental suffocation---E921-E925	36	1	0	1	3	25	7
Lack of care of infant---E926	5	5	5	0	-	0	0
Other accidents---Remainder of E800-E999	12	2	2	0	1	4	5
All other causes---Residual	206	94	46	48	22	51	34

NOTE: Rates based upon less than an annual average of 20 deaths are underscored as a warning to users that the smallness of the experience may affect their significance.

Table 6. Live birth, perinatal, stillbirth, and infant mortality rates for males: England and Wales, 1901-63

Year	Live birth[1]	Perinatal mortality[1,2]	Stillbirth[1]	Infant mortality[2]
	Rate per 1,000 population	Rate per 1,000 total births		Rate per 1,000 live births
1963	19.3	31.4	17.6	23.7
1962	19.1	32.8	18.1	24.5
1961	18.7	33.8	19.0	23.9
1960	18.3	34.7	19.6	24.5
1959	17.6	35.9	20.9	24.5
1958	17.5	37.2	21.8	25.3
1957	17.2	38.4	22.6	25.8
1956	16.7	39.3	23.4	26.8
1955	16.1	39.9	23.6	28.1
1954	16.3	40.5	23.9	28.7
1953	16.6	39.4	23.1	29.8
1952	16.4	40.4	23.6	30.8
1951	16.6	41.8	24.3	33.8
1950	16.8	40.7	23.7	33.6
1949	17.7	41.1	23.7	36.8
1948	18.9	41.7	24.3	38.7
1947	21.8	43.5	25.3	46.8
1946	20.5	48.0	28.4	46.1
1945	17.0	48.5	28.8	52.5
1944	18.9	47.5	28.8	49.4
1943	17.3	51.3	31.5	54.4
1942	16.6	55.3	34.1	55.3
1941	14.7	59.1	36.5	67.0
1940	15.0	62.4	39.0	65.1
1939	15.8	62.5	39.8	56.6
1938	16.1	63.1	40.2	59.5
1937	15.9	64.6	41.2	64.7
1936	15.9	65.8	42.1	66.2
1935	15.8	66.7	42.9	63.9
1934	15.8	67.2	42.7	65.4
1933	15.3	68.5	43.8	71.8
1932	16.3	68.8	44.2	73.4
1931	16.9	68.1	44.2	75.2
1930	17.4	67.8	44.0	68.2
1926-30	17.8	---	---	76.6
1921-25	21.3	---	---	85.6
1916-20	24.8	---	---	100.6
1911-15	25.5	---	---	121.4
1906-10	27.7	---	---	129.0
1901-5	29.7	---	---	151.4

[1]Prior to 1939, births were allocated to the year of registration; beginning with 1939, to the year of birth.

[2]Prior to 1939, mortality rates are based on births registered, and subsequently on births occurring in the year specified.

Table 7. Live birth, perinatal, stillbirth, and infant mortality rates for females: England and Wales, 1901-63

Year	Live birth[1]	Perinatal mortality[1,2]	Stillbirth[1]	Infant mortality[2]
	Rate per 1,000 population	Rate per 1,000 total births		Rate per 1,000 live births
1963	17.2	27.0	16.8	18.3
1962	16.9	28.8	18.1	18.7
1961	16.5	30.1	19.1	18.8
1960	16.1	30.8	19.9	18.9
1959	15.4	32.2	20.7	19.8
1958	15.4	32.7	21.2	19.6
1957	15.1	33.9	22.3	20.3
1956	14.7	34.1	22.4	20.3
1955	14.1	34.8	22.7	21.5
1954	14.2	35.4	23.1	22.0
1953	14.5	34.1	21.7	23.6
1952	14.4	34.4	21.7	24.1
1951	14.4	34.3	21.8	25.7
1950	14.9	33.9	21.4	25.9
1949	15.7	34.6	21.6	28.3
1948	16.8	35.1	22.0	30.1
1947	19.2	37.0	22.9	36.6
1946	18.0	40.4	25.8	35.3
1945	14.9	41.8	26.5	41.1
1944	16.6	41.3	26.3	39.3
1943	15.2	44.3	28.7	42.9
1942	14.5	48.6	32.2	43.3
1941	13.1	50.0	32.9	51.9
1940	13.3	52.8	35.2	49.4
1939	13.9	54.3	36.2	44.6
1938	14.1	53.8	36.2	45.5
1937	13.9	55.6	36.7	50.2
1936	13.9	55.4	37.3	50.4
1935	13.8	56.7	38.5	49.6
1934	13.8	56.8	38.1	51.4
1933	13.5	58.0	39.0	55.2
1932	14.3	56.5	38.4	56.3
1931	14.8	55.7	37.4	57.1
1930	15.3	55.6	37.4	51.4
1926-30	15.7	---	---	58.7
1921-25	18.6	---	---	66.0
1916-20	18.8	---	---	78.7
1911-15	22.4	---	---	97.3
1906-10	24.9	---	---	104.7
1901-5	26.8	---	---	123.8

[1]Prior to 1939, births were allocated to the year of registration; beginning with 1939, to the year of birth.

[2]Prior to 1939, mortality rates are based on births registered, and subsequently on births occurring in the year specified.

Table 8. Infant mortality rates, by cause of death: England and Wales, 1950-63

Cause of death Sixth Revision of International Lists, 1948	
All causes	
Tuberculosis of meninges and central nervous system	010
Other tuberculosis	001-008,011-019
Congenital syphilis	020
Whooping cough	056
Meningococcal infections	057
Acute poliomyelitis	080,081
Measles	085
Other infective and parasitic diseases	Remainder of 001-138
Malignant neoplasms (including neoplasms of lymphatic and hematopoietic tissues)	140-205
Diseases of the endocrine glands	250-277
Hemorrhagic conditions	295,296,771
Vascular lesions affecting central nervous system	330-334
Meningitis, except meningococcal and tuberculosis	340
Inflammatory diseases of central nervous system except meningitis	341-343
Diseases of ear and mastoid process	390-398
Influenza	480-483
Pneumonia	490-493,763
Bronchitis	500-502
Other respiratory diseases	470-475,510-527
Gastritis and duodenitis	543
Gastroenteritis	571,764
Diseases of the skin and cellular tissue	690-716
Spina bifida and meningocele	751
Congenital hydrocephalus	752
Congenital malformations of heart[2]	754.0-754.5
Congenital malformations of genitourinary system	757
Other congenital malformations	Remainder of 750-759
Birth injury	760,761
Postnatal asphyxia and atelectasis	762
Pemphigus and sepsis of newborn	766-768
Hemolytic disease of newborn	770
Immaturity	774,776
Accidental falls	E900-E904
Accident by fire or hot substance	E916,E917
Obstruction by inhalation or ingestion	E921,E922
Accidental mechanical suffocation	E924,E925
Lack of care of infant	E926
Other accidents	Remainder of E800-E965
All other causes	Residual

[1]For 1950-56, rates are based on related live births. For 1957-63, rates are based on live births occurring in the year specified.

[2]For 1950-57, includes cause-of-death numbers 754.0-754.4.

NOTE: Rates based upon fewer than 20 deaths are underscored as a warning to users that the smallness of the experience may affect their significance.

Table 8. Infant mortality rates, by cause of death: England and Wales, 1950-63—Con.

1963	1962	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950
Rate per 100,000 live births[1]													
2,113	2,168	2,144	2,181	2,222	2,253	2,311	2,375	2,491	2,542	2,682	2,759	2,966	2,963
0	1	1	0	1	0	0	1	2	1	2	6	8	6
0	0	1	1	1	1	1	1	2	4	7	4	6	11
-	0	-	-	0	0	-	0	-	0	1	3	3	4
3	2	2	3	2	2	9	9	9	14	24	17	40	38
7	7	7	6	8	10	11	10	11	15	18	17	15	14
-	-	0	-	0	-	1	1	1	0	1	2	1	8
3	0	4	1	3	2	3	0	6	2	8	5	14	10
9	10	8	10	10	10	8	10	8	12	14	11	11	11
7	7	7	7	7	8	8	6	7	7	7	9	8	7
6	7	5	4	5	6	6	6	7	8	8	8	8	6
26	29	24	27	30	35	27	33	33	34	30	28	35	29
3	2	2	4	3	2	3	4	2	2	2	2	2	4
16	19	19	16	15	19	20	18	18	18	24	17	22	22
3	4	4	2	3	5	3	3	4	3	3	4	4	7
7	7	4	5	7	5	6	9	10	10	14	10	17	20
4	5	4	3	9	4	11	4	7	4	11	5	24	11
334	311	285	307	297	310	301	331	347	353	431	448	509	463
54	49	39	46	52	47	40	45	53	49	63	56	67	67
17	12	13	11	12	14	12	13	14	14	14	13	17	17
0	0	1	0	0	0	0	0	1	1	2	3	2	2
46	54	48	44	40	36	44	46	66	68	97	101	122	163
1	1	2	1	1	2	3	3	3	3	5	7	6	7
83	68	76	83	89	99	101	109	113	112	92	100	92	81
17	53	56	57	55	47	47	50	51	50	43	50	42	50
158	163	152	149	151	151	159	159	147	158	153	150	144	155
21	21	18	21	15	18	20	16	19	16	14	15	13	16
140	151	143	141	143	142	135	126	132	132	127	141	129	131
228	222	252	232	247	244	253	264	268	270	262	272	282	255
294	319	326	341	362	357	372	340	345	355	349	349	344	321
9	7	10	8	7	9	11	10	8	11	11	10	10	10
40	42	41	47	48	51	51	50	54	68	59	65	74	71
334	356	373	391	385	400	430	455	475	476	518	535	570	599
4	3	3	2	3	2	2	1	2	1	1	2	2	1
3	3	2	2	3	2	1	1	2	3	2	3	3	2
29	30	27	24	25	27	28	36	36	37	32	39	41	44
17	19	15	17	19	24	22	27	27	27	29	36	43	40
7	5	6	4	7	7	8	6	9	8	12	14	15	12
8	6	6	6	5	6	5	5	6	4	6	5	5	3
171	173	160	154	150	147	135	160	178	184	178	193	217	238

Table 9. Neonatal mortality rates, by cause of death: England and Wales, 1950-63

Cause of death Sixth Revision of International Lists, 1948	
All causes	
Influenza	480-483
Pneumonia	490-493,763
Bronchitis	500-502
Other respiratory diseases	470-475,510-527
Gastritis and duodenitis	543
Gastroenteritis	571,764
Spina bifida and meningocele	751
Congenital hydrocephalus	752
Congenital malformations of heart[2]	754.0-754.5
Congenital malformations of genitourinary system	757
Other congenital malformations	Remainder of 750-759
Birth injury	760,761
Postnatal asphyxia and atelectasis	762
Pemphigus and sepsis of newborn	766-768
Hemolytic disease of newborn	770
Immaturity	774,776
Accidental suffocation	E921-E925
Lack of care of infant	E926
Other accidents	Remainder of E800-E999
All other causes	Residual

[1]For 1951-56, rates are based on related live births. For 1950 and 1957-63, rates are based on live births occurring in the year specified.

[2]For 1950-57, includes cause-of-death numbers 754.0-754.4

NOTE: Rates based upon fewer than 20 deaths are underscored as a warning to users that the smallness of the experience may affect their significance.

Table 10. Postneonatal mortality rates, by cause of death: England and Wales, 1950-63

Cause of death Sixth Revision of International Lists, 1948	
All causes	
Influenza	480-483
Pneumonia	490-493,763
Bronchitis	500-502
Other respiratory diseases	470-475,510-527
Gastritis and duodenitis	543
Gastroenteritis	571,764
Spina bifida and meningocele	751
Congenital hydrocephalus	752
Congenital malformations of heart[2]	754.0-754.5
Congenital malformations of genitourinary system	757
Other congenital malformations	Remainder of 750-759
Birth injury	760,761
Postnatal asphyxia and atelectasis	762
Pemphigus and sepsis of newborn	766-768
Hemolytic disease of newborn	770
Immaturity	774,776
Accidental suffocation	E921-E925
Lack of care of infant	E926
Other accidents	Remainder of E800-E999
All other causes	Residual

See footnotes at end of table 9.

Table 9. Neonatal mortality rates, by cause of death: England and Wales, 1950-63—Con.

1963	1962	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950
Rate per 100,000 live births[1]													
1,422	1,509	1,534	1,553	1,587	1,616	1,646	1,682	1,724	1,773	1,766	1,830	1,887	1,853
0	0	0	1	1	0	1	1	1	1	1	0	2	1
79	91	87	93	100	113	99	115	117	113	130	136	140	121
2	4	3	4	3	3	4	4	4	4	6	4	5	5
2	3	3	3	3	4	3	3	4	3	4	3	3	4
0	-	1	-	-	-	0	-	0	0	1	1	0	0
7	7	8	6	6	5	5	7	6	6	9	10	14	14
53	43	46	52	54	59	61	69	70	74	61	67	63	---
9	30	31	29	27	28	24	27	29	31	26	30	24	---
86	95	85	86	83	83	87	86	79	92	80	85	84	92
15	16	13	14	11	12	14	11	12	10	9	8	8	9
108	113	107	107	110	106	96	92	97	98	91	98	89	83
227	222	252	232	247	243	249	260	265	267	258	266	277	---
290	316	323	338	359	354	370	337	341	351	345	341	335	---
9	7	9	7	6	8	6	7	7	9	9	9	8	7
39	41	40	47	47	50	50	49	53	67	58	61	71	68
330	351	368	386	381	393	426	449	468	470	508	522	559	585
3	4	5	5	5	4	5	7	7	6	7	10	10	13
7	5	6	4	7	7	8	6	8	8	11	14	15	12
4	3	2	3	3	2	2	3	5	5	4	4	3	5
152	158	145	136	134	142	136	149	151	158	148	161	177	---

Table 10. Postneonatal mortality rates, by cause of death: England and Wales, 1950-63—Con.

1963	1962	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950
Rate per 100,000 live births[1]													
685	659	610	628	634	637	666	682	763	774	911	924	1,097	1,133
4	4	4	3	8	4	9	4	7	4	10	5	22	10
255	220	198	214	197	197	202	213	230	242	300	311	372	349
51	45	36	43	49	44	36	41	49	46	57	51	63	64
14	9	10	9	9	10	9	9	10	12	10	10	13	13
0	0	0	0	0	0	-	0	1	1	1	2	2	2
39	47	40	38	34	32	39	39	60	62	88	91	109	152
30	26	30	31	35	41	40	40	44	39	31	32	29	---
7	24	25	29	29	19	23	23	23	20	17	19	18	---
71	68	68	64	68	67	72	72	68	66	73	64	61	64
5	6	4	6	4	6	6	5	7	6	6	7	5	6
33	38	35	35	34	36	39	34	35	34	36	43	41	48
0	-	0	0	0	0	4	3	3	2	4	5	5	---
3	3	4	3	3	3	2	3	4	4	4	8	11	---
0	0	1	1	1	1	5	3	1	2	2	1	2	2
0	1	1	1	1	0	1	1	1	2	2	3	3	4
3	5	4	4	4	7	4	5	7	6	10	12	14	16
43	45	37	37	38	46	45	56	55	59	54	65	75	72
0	0	0	-	0	-	0	0	1	1	1	1	0	1
13	11	11	11	12	10	10	7	9	8	10	11	10	8
114	107	102	99	108	114	120	124	148	158	195	183	242	---

Table 11. Neonatal and first-day mortality rates among low birth weight infants, by birth weight: England and Wales, 1953-63

Year	2,500 grams or less		1,500 grams or less		1,501-2,000 grams		2,001-2,250 grams		2,251-2,500 grams	
	Under 28 days	Under 24 hours	Under 28 days	Under 24 hours	Under 28 days	Under 24 hours	Under 28 days	Under 24 hours	Under 28 days	Under 24 hours
	Rate per 1,000 live births in specified weight group									
1963	128	80	626	444	162	90	60	30	31	14
1962	133	83	656	475	163	92	64	30	36	15
1961	139	84	651	447	170	96	70	34	36	14
1960	138	85	665	469	173	95	73	36	34	14
1959	142	85	663	461	184	100	71	31	38	16
1958	142	81	669	449	183	93	69	31	41	15
1957	144	82	665	443	177	93	71	31	41	15
1956	146	82	666	442	184	93	80	32	39	14
1955	149	82	682	445	188	90	81	31	39	15
1954	152	82	685	449	199	91	81	34	44	15
1953	155	84	687	441	201	97	79	32	41	15

Table 12. Number and percentage distribution of low birth weight infants, by birth weight: England and Wales, 1953-63

Year	Number	Total	1,500 grams or less	1,501-2,000 grams	2,001-2,250 grams	2,251-2,500 grams
		Percentage distribution				
1963	56,172	100	11	18	21	49
1962	55,999	100	11	17	21	50
1961	54,632	100	12	18	20	50
1960	52,633	100	11	18	20	50
1959	50,310	100	12	17	20	51
1958	50,742	100	11	18	20	51
1953-57	235,295	100	12	18	20	50

NOTE: Percentages do not always add to 100 percent because of rounding.

Table 13. Perinatal, stillbirth, and infant mortality rates for specified congenital malformations of the central nervous system, by sex: England and Wales, 1950-52, 1959-61, and 1962

Cause of death and year	Both sexes	Male	Female
SPINA BIFIDA			
Perinatal	Rate per 1,000 total births		
1962	0.6	0.5	0.7
Stillbirth			
1962	0.4	0.3	0.4
Infant	Rate per 1,000 live births		
1962	0.7	0.5	0.9
1959-61	0.8	0.7	1.0
1950-52	0.9	0.7	1.1
HYDROCEPHALUS			
Perinatal	Rate per 1,000 total births		
1962	0.8	0.8	0.8
Stillbirth			
1962	0.6	0.7	0.6
Infant	Rate per 1,000 live births		
1962	0.5	0.4	0.7
1959-61	0.6	0.5	0.6
1950-52	0.5	0.4	0.5
ANENCEPHALUS AND MONSTROSITY			
Perinatal	Rate per 1,000 total births		
1962	2.1	1.2	3.0
ANENCEPHALUS			
Stillbirth			
1962	1.8	1.0	2.7
MONSTROSITY			
Infant	Rate per 1,000 live births		
1962	0.2	0.2	0.3
1959-61	0.2	0.2	0.3
1950-52	0.1	0.1	0.2

Table 14. Number and percentage distribution of perinatal deaths and perinatal mortality rates, by time of death and primary necropsy findings: England, Scotland, and Wales, March 1958

[Mortality rates are based on total births or live births in the month of March estimated from data for the control week March 3-9, 1958]

Primary necropsy finding	Perinatal deaths			Stillbirths			Under 7 days		
	Number	Percentage distribution	Rate per 1,000 total births	Number	Percentage distribution	Rate per 1,000 total births	Number	Percentage distribution	Rate per 1,000 live births
Total	2,358	...	33.2	1,526	...	21.5	832	...	12.0
Without necropsy	170	...	2.4	119	...	1.7	51	...	0.7
With necropsy	2,188	100.0	30.8	1,407	100.0	19.8	781	100.0	11.3
Congenital malformation	415	19.0	5.8	246	17.5	3.5	169	21.6	2.4
Isoimmunization	95	4.3	1.3	62	4.4	0.9	33	4.2	0.5
Antepartum anoxia	245	11.2	3.4	245	17.4	3.4	...	...	...
Antepartum death (no major lesion)	239	10.9	3.4	239	17.0	3.4	...	...	...
Intrapartum anoxia	501	22.9	7.1	433	30.8	6.1	68	8.7	1.0
Intrapartum anoxia and cerebral birth trauma	151	6.9	2.1	110	7.8	1.5	41	5.3	0.6
Cerebral birth trauma	68	3.1	1.0	24	1.7	0.3	44	5.6	0.6
Hyaline membrane	117	5.3	1.6	...	...	...	117	15.0	1.7
Intraventricular hemorrhage	50	2.3	0.7	...	...	...	50	6.4	0.7
Neonatal death (no histological lesion)	68	3.1	1.0	...	...	...	68	8.7	1.0
Pulmonary infection	104	4.8	1.5	...	...	...	104	13.3	1.5
Massive pulmonary hemorrhage	46	2.1	0.6	...	...	...	46	5.9	0.7
Other	89	4.1	1.3	48	3.4	0.6	41	5.2	0.5

Source: N. R. Butler and D. G. Bonham, Perinatal Mortality, E.& S. Livingstone, Ltd., Edinburgh and London, 1963. (Adapted from table 65.) The authors are indebted to the National Birthday Trust Fund and the publishers for permission to use the data.

Table 15. Stillbirth and infant mortality rates for all births and illegitimate births, by age at death, and index numbers: England and Wales, selected years, 1936-61

Age at death	1936-1939	1961	1936-1939	1940-1944	1945-1949	1950-1954	1956	1958	1960	1961
Stillbirths	Rate[1]		Index number							
Total births	38.8	19.0	100	83	64	59	59	55	51	49
Illegitimate births	49.6	24.2	100	80	63	60	58	57	50	49
Under 7 days										
Total births	21.6	13.2	100	89	77	70	66	61	62	62
Illegitimate births	34.4	17.5	100	82	69	60	55	53	49	51
7-27 days										
Total births	7.6	2.1	100	99	72	41	34	32	29	28
Illegitimate births	10.7	2.0	100	98	76	36	25	21	24	18
28 days-11 months										
Total births	25.6	6.1	100	96	66	37	27	25	24	24
Illegitimate births	41.6	5.8	100	86	56	27	17	17	17	14

[1]Stillbirth rates are per 1,000 total births; other rates are per 1,000 live births.

Table 16. Average annual live birth, perinatal, stillbirth, and infant mortality rates, by standard regions: England and Wales, 1960-62

Standard region	Live birth	Perinatal	Stillbirth	Infant mortality		
				Under 1 year	Under 28 days	28 days-11 months
	Rate per 1,000 population	Rate per 1,000 total births		Rate per 1,000 live births		
England and Wales	17.6	31.9	18.9	21.6	15.3	6.3
Northern	18.5	35.2	21.2	24.0	16.9	7.1
East and West Yorkshire	17.6	33.2	19.8	23.4	16.1	7.4
North Western	18.3	35.8	21.1	25.6	17.5	8.1
North Midland	17.9	31.7	19.6	21.0	14.6	6.4
Midland	18.5	33.2	20.1	22.0	15.5	6.5
Eastern	17.9	28.3	16.9	18.1	13.2	4.9
London and South Eastern	16.6	28.9	16.6	19.5	14.4	5.2
Southern	18.2	27.6	16.0	19.3	13.6	5.7
South Western	16.5	29.9	18.1	19.1	13.9	5.2
Wales	17.0	37.3	22.6	24.9	17.7	7.2

Table 17. Average annual live birth, perinatal, stillbirth, and infant mortality rates, by conurbations and urban and rural aggregates outside conurbations: England and Wales, 1960-62

Area	Live birth	Perinatal mortality	Stillbirth	Infant mortality		
				Under 1 year	Under 28 days	28 days-11 months
	Rate per 1,000 population	Rate per 1,000 total births		Rate per 1,000 live births		
England and Wales----	17.6	31.9	18.9	21.6	15.3	6.3
Conurbation						
Total----------	17.9	32.2	18.6	22.4	15.9	6.6
Tyneside----------	18.5	35.2	21.2	24.0	16.9	7.1
West Yorkshire----------	17.5	33.0	19.3	23.9	16.1	7.8
South East Lancashire------	18.3	35.5	20.6	26.1	17.7	8.4
Merseyside----------	20.9	36.9	21.3	27.4	18.1	9.3
West Midlands----------	19.0	33.2	19.8	22.2	15.6	6.6
Greater London----------	16.9	29.3	16.6	19.8	14.7	5.1
Outside conurbation						
Urban areas with population of 100,000 and over-------	17.5	32.8	19.3	23.0	16.2	6.9
Urban areas with population of 50,000-99,999----------	17.5	32.1	19.4	21.4	15.0	6.4
Urban areas with population under 50,000----------	17.4	32.1	19.5	21.3	15.0	6.3
Rural districts----------	17.3	30.4	18.4	19.7	14.2	5.5

Table 18. Percentage distribution of births for each social class, by pregnancy outcome: England, Scotland, and Wales, March 1958

[Includes total single births for control week, March 3-9, 1958. Perinatal deaths for March 1958 are related to estimated births for the same month]

Pregnancy outcome and cause of death	I Professional and managerial	II Supervisory	III Skilled workers	IV Partly skilled workers	V Unskilled workers	Unspecified[1]
	Percentage distribution					
Total births	100.0	100.0	100.0	100.0	100.0	100.0
Survivors[2]	98.0	97.1	96.7	96.7	95.8	95.3
Perinatal deaths[3]	2.0	2.9	3.3	3.3	4.2	4.7
Cause of death:						
Antepartum stillbirth	0.5	0.5	0.7	0.8	0.7	1.0
Intrapartum anoxia and/or trauma	0.7	0.9	1.0	0.9	1.3	1.6
Respiratory distress syndrome	0.2	0.3	0.3	0.3	0.4	0.4
Pulmonary infection	0.0	0.1	0.1	0.2	0.2	0.3
Congenital malformations	0.1	0.5	0.6	0.5	0.8	0.7
Other	0.5	0.6	0.6	0.7	0.8	0.7

[1]Includes illegitimate births and those for which social class of father is unspecified.

[2]Survivors include liveborn infants who survived the first week of life.

[3]Perinatal deaths include stillbirths and liveborn infants who died within the first week of life.

Table 19. Percentage distribution of births, by mother's blood pressure and maternal complications, and by pregnancy outcome: England, Scotland, and Wales, March 1958

[Includes total single births for control week, March 3-9, 1958. Perinatal deaths for March 1958 are related to estimated births for the same month]

Mother's maximum diastolic blood pressure level in late pregnancy	Total births	Maternal complication	
		Antepartum hemorrhage	Early delivery (gestation of 28-35 weeks)
	Percentage distribution	Percent of total births in specified group	
Total	100.0	3.1	3.2
Normotensive (89 mm or less)	64.7	2.5	2.8
Mild toxemia (90-99 mm)	15.7	3.4	2.5
Moderate toxemia (100-109 mm)	3.6	3.4	1.5
Severe toxemia (110 mm or higher) and all cases with 90 mm or higher and proteinuria	5.6	4.5	5.5
Essential hypertension with or without proteinuria	2.6	3.8	3.2
Other and unspecified	7.8	6.1	7.2

[1]Survivors include liveborn infants who survived the first week of life.

[2]Perinatal deaths include stillbirths and liveborn infants who died within the first week of life.

Table 20. Percentage distribution of births, by type of bleeding and maternal complications, and by pregnancy outcome: England, Scotland, and Wales, March 1958

[See headnote on table 19]

Bleeding in pregnancy	Total births	Maternal complication	
		Hypertension	Early delivery (gestation of 28-35 weeks)
	Percentage distribution	Percent of total births in specified group	
Total	100.0	27.5	34.4
No bleeding during pregnancy	94.0	27.3	2.7
Threatened abortion only	2.9	26.7	3.6
Accidental antepartum hemorrhage	0.4	43.3	37.3
Placenta previa	0.5	28.8	18.8
Unspecified antepartum hemorrhage	2.2	31.3	14.5

[1]Survivors include liveborn infants who survived the first week of life.

[2]Perinatal deaths include stillbirths and liveborn infants who died within the first week of life.

Table 19. Percentage distribution of births, by mother's blood pressure and maternal complications, and by pregnancy outcome: England, Scotland, and Wales, March 1958—Con.

[Includes total single births for control week, March 3-9, 1958. Perinatal deaths for March 1958 are related to estimated births for the same month]

Total births	Survivors[1]	Perinatal deaths[2]	Cause of death				
			Antepartum stillbirth	Intrapartum anoxia and/or trauma	Respiratory distress syndrome	Pulmonary infection	Other
Percentage distribution							
100.0	96.7	3.3	0.7	1.0	0.3	0.1	1.1
100.0	97.6	2.4	0.4	0.7	0.2	0.1	1.0
100.0	97.0	3.0	0.6	1.1	0.1	0.1	1.1
100.0	95.6	4.4	1.3	1.5	0.2	0.1	1.3
100.0	92.0	8.0	2.7	2.5	0.8	0.3	1.7
100.0	95.7	4.3	1.0	1.1	0.7	0.1	1.4
100.0	93.1	6.9	1.2	2.1	1.0	0.3	2.3

Table 20. Percentage distribution of births, by type of bleeding and maternal complications, and by pregnancy outcome: England, Scotland, and Wales, March 1958—Con.

[See headnote on table 19]

Total births	Survivors[1]	Perinatal deaths[2]	Cause of death				
			Antepartum stillbirth	Intrapartum anoxia and/or trauma	Respiratory distress syndrome	Pulmonary infection	Other
Percentage distribution							
100.0	96.7	3.3	0.7	1.0	0.3	0.1	1.1
100.0	97.3	2.7	0.6	0.7	0.2	0.1	1.1
100.0	92.5	7.5	1.1	1.7	2.4	0.4	1.9
100.0	44.3	55.7	6.8	35.4	5.7	1.4	6.4
100.0	88.3	11.7	-	5.1	2.7	0.6	3.3
100.0	86.8	13.2	2.9	5.0	1.8	0.7	2.9

Table 21. Percentage distribution of births, by period of gestation and by pregnancy outcome: England, Scotland, and Wales, March 1958

[Includes total single births for control week, March 3-9, 1958. Perinatal deaths for March 1958 are related to estimated births for the same month]

Period of gestation	Percentage distribution of total births	Total births	Survivors[1]	Perinatal deaths[2]	Cause of death				
					Antepartum stillbirth	Intrapartum anoxia and/or trauma	Respiratory distress syndrome	Pulmonary infection	Other
	Percentage distribution								
Total[3]	100.0	100.0	96.8	3.2	0.7	1.0	0.3	0.1	1.1
28-29 weeks	0.2	100.0	33.2	66.8	13.2	14.4	17.6	3.8	17.8
30-31 weeks	0.5	100.0	44.1	55.9	13.7	9.9	12.7	0.6	19.0
32-33 weeks	0.8	100.0	67.3	32.7	7.1	5.4	5.7	1.2	13.3
34-35 weeks	1.7	100.0	80.6	19.4	5.5	4.9	1.2	0.5	7.3
36-37 weeks	6.1	100.0	92.9	7.1	2.0	1.7	0.4	0.2	2.8
38-39 weeks	28.4	100.0	98.2	1.8	0.4	0.6	0.0	0.1	0.7
40-41 weeks	43.0	100.0	98.6	1.4	0.2	0.7	0.0	0.1	0.4
42 weeks and over	11.5	100.0	97.4	2.6	0.4	1.2	0.1	0.2	0.7
Gestation uncertain	7.7	100.0	95.4	4.6	0.8	1.3	0.6	0.3	1.6

[1]Survivors include liveborn infants who survived the first week of life.

[2]Perinatal deaths include stillbirths and liveborn infants who died within the first week of life.

[3]Excludes gestations under 28 weeks.

Table 22. Incidence of perinatal death risk factors among low birth weight infants, by period of gestation: England, Scotland, and Wales, March 3-9, 1958

[Includes total single births weighing 2,500 grams or less]

Risk factor	Period of gestation		
	Under 36 weeks	36-38 weeks	39 weeks and over
	Percent		
Total	100.0	100.0	100.0
Hypertension in mother	25.0	36.0	37.0
Primiparae	38.0	41.0	48.0
Previous perinatal death	18.0	14.0	9.0
Height of mother under 5 feet	4.0	8.0	10.0
Fetal distress in labor	2.5	3.5	5.9
Breech delivery	17.0	4.2	3.8

NOTE: Percentages for the periods of gestation add to more than 100.0 because more than one risk factor may occur in a single infant.

Table 23. Percentage distribution of births for each gestation group, by pregnancy outcome: England, Scotland, and Wales, March 1958

[Includes total single births weighing 2,500 grams or less for control week, March 3-9, 1958. Perinatal deaths for March 1958 are related to estimated births for the same month. Excludes macerated stillbirths and deaths from congenital malformations]

Pregnancy outcome and cause of death	Period of gestation		
	Under 36 weeks	36-38 weeks	39 weeks and over
	Percentage distribution		
Total births	100.0	100.0	100.0
Survivors[1]	63.0	91.8	94.7
Perinatal deaths[2]	37.0	8.2	5.3
Cause of death:			
Intrapartum anoxia and/or trauma	13.0	4.1	2.1
Respiratory distress syndrome	15.0	1.6	0.8
Pulmonary infection	4.0	1.0	0.9
Other	5.0	1.5	1.5

[1]Survivors include liveborn infants who survived the first week of life.

[2]Perinatal deaths include stillbirths and liveborn infants who died within the first week of life.

Table 24. Percentage distribution of births, by birth weight and method of delivery, and by pregnancy outcome: England, Scotland, and Wales, March 1958

[Includes total single births for control week, March 3-9, 1958. Perinatal deaths for March 1958 are related to estimated births for the same month]

Birth weight and method of delivery	Percent of total births	Total births	Survivors[1]	Perinatal deaths[2]	Cause of death				
					Antepartum stillbirth	Intrapartum anoxia and/or trauma	Respiratory distress syndrome	Pulmonary infection	Other
	Percentage distribution								
All birth weights---	100.0	100.0	96.7	3.3	0.7	1.0	0.3	0.1	1.1
Spontaneous vertex, occipito-anterior--------	85.4	100.0	97.8	2.2	0.6	0.6	0.2	0.1	0.7
Spontaneous vertex, occipito-posterior-------	2.4	100.0	97.1	2.9	0.3	0.9	0.5	0.2	1.0
Forceps to vertex---------	4.7	100.0	95.7	4.3	0.1	3.0	0.1	0.1	1.1
Breech--------------------	2.2	100.0	75.5	24.5	4.9	8.6	2.3	0.4	8.2
Cesarean section----------	2.7	100.0	93.2	6.8	0.1	2.1	2.5	0.3	1.8
Other and unspecified-----	2.6	100.0	83.1	16.9	1.8	3.2	1.4	0.4	10.1
Births of 2,500 grams or less------	6.7	100.0	73.3	26.7	6.5	5.1	4.4	1.0	9.6
Spontaneous vertex, occipito-anterior--------	4.9	100.0	80.0	20.0	5.0	3.6	2.7	1.4	7.3
Breech--------------------	0.6	100.0	38.1	61.9	16.0	15.7	8.1	1.4	20.7
Cesarean section----------	0.3	100.0	66.0	34.0	-	5.6	11.0	0.9	16.5
Other and unspecified-----	0.9	---	---	---	---	---	---	---	---

[1]Survivors include liveborn infants who survived the first week of life.

[2]Perinatal deaths include stillbirths and liveborn infants who died within the first week of life.

Table 25. Incidence of short gestation or low birth weight, and percentage distribution of births, by pregnancy outcome for plurality groups: England, Scotland, and Wales, March 1958

[See headnote on table 24]

Pregnancy outcome and cause of death	Single birth	Twin births	
		Twin I	Twin II
	Percent of births in specified plurality group		
Births of 28-35 weeks of gestation----------	3.2	17.6	17.6
Births of 2,500 grams or less----------	6.7	50.5	57.8
	Percentage distribution		
Total births----------	100.0	100.0	100.0
Survivors[1]----------	96.7	89.0	85.0
Perinatal deaths[2]----------	3.3	11.0	15.0
Cause of death:			
Antepartum stillbirth----------	0.7	1.9	3.9
Intrapartum anoxia and/or trauma----------	1.0	2.3	3.8
Respiratory distress syndrome----------	0.3	1.6	2.9
Pulmonary infection----------	0.1	1.4	0.6
Other----------	1.1	3.8	4.0

See footnotes on table 24.

APPENDIX I

DEFINITIONS

Live birth: There is no legal limitation of the period of gestation at which a birth may be regarded as live. The criterion is that the child shows signs of life after complete expulsion from its mother, whatever the period of gestation. The changing interpretation of the words "signs of life" is discussed on page 8.

Stillbirth: "A stillborn child means a child which has issued forth from its mother after the 28th week of pregnancy and which did not at any time after being completely expelled from its mother breathe or show any other signs of life, and the expression 'stillbirth' shall be construed accordingly."[d]

Total births: All live births and stillbirths.

Abortion: Expulsion from the uterus of a dead fetus before the completion of 28 weeks of pregnancy.

Infant death: Death of a liveborn infant under the age of 1 year.

Neonatal death: Death of a liveborn infant under the age of 4 weeks (less than 28 days).

Early neonatal death: Death of a liveborn infant under the age of 1 week (less than 7 days).

Late neonatal death: Death of a liveborn infant aged 1 week or over but under 4 weeks (7 through 27 days).

Postneonatal death: Death of a liveborn infant aged 4 weeks or over but under 1 year (28 days through 11 months).

Perinatal deaths: Stillbirths and early neonatal deaths.

Causes of death (as defined in the British Perinatal Mortality Survey, 1958, based on necropsy findings):

Antepartum stillbirth includes stillbirths occurring after the 28th week of pregnancy but before the onset of labor, which were not due to congenital malformation, isoimmunization, or other necropsy lesion except the changes of asphyxia. It includes the necropsy findings "antepartum stillbirth with no lesion" and "antepartum anoxia."

Intrapartum anoxia and/or cerebral birth trauma includes intrapartum anoxia, manifested by small hemorrhages on the visceral pleura and pericardium, and in the cortex of the thymus with congestion of all viscera, especially the liver, spleen, and adrenal medulla. Gross meconium aspiration, subcapsular hematoma of liver, mesenteric and perirenal hemorrhages, interstitial emphysema, or pneumothorax were also sometimes present. Microscopy of the lungs confirmed the presence of hemorrhages and in most cases showed evidence of inhalation of amniotic debris and meconium into alveolar ducts, bronchi, and alveoli. This group also includes cerebral birth trauma with evidence of subdural hemorrhage associated with laceration of the falx, tentorium, or great cerebral vein.

Respiratory distress syndrome includes atelectasis with pulmonary hyaline membranes; intraventricular hemorrhage, often coexisting with pulmonary hyaline membranes; and babies without obvious pathological lesions even on histological examination of the lungs.

[d]Births and Deaths Registration Act, 1926.

APPENDIX II

REGISTRATION AND NOTIFICATION PROCEDURES

Birth Registration

A birth, whether a live birth or a stillbirth, must be registered within 42 days of the occurrence. This is usually done by one of the parents. The registrar records the date and place of birth, the sex of the infant, the name and place of residence of the parents, and the father's occupation. Since 1938 additional confidential information is obtained for statistical purposes only and is not entered in the Births Register, namely, the father's age, the mother's age and (in legitimate births) the date of marriage, whether previously married, and the number of previous children, liveborn or stillborn, by the present and previous marriages.

In the case of a stillbirth the informant must normally give the registrar a statutory certificate signed by a doctor or midwife stating that the child was not born alive. Since October 1960 in England and Wales, the doctor or midwife is required to state the cause of the stillbirth on this certificate. (In Scotland, registration of cause of death for stillbirths started in 1939.) Information is also requested on birth weight and the estimated duration of the pregnancy.

Certificates of stillbirth, including cause, were signed by midwives in 37 percent of the stillbirths in the fourth quarter of 1961 and in 14 percent of those in the third quarter of 1962.

Birth Notification

A birth, whether a live birth or a stillbirth, must be notified to the local Medical Officer of Health within 36 hours of the occurrence. This is usually done by the midwife or doctor on forms provided by the local public health department, stating the date and place of birth, the sex of the infant, and the names and place of residence of the parents.

Since 1944 the doctor or midwife has been asked to state on the notification form the birth weight if it was 2,500 grams or less. From 1953 the birth weight has been requested in all cases. Since 1964 the doctor or midwife has been asked to record on the notification form any congenital malformation observed at birth.

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APPENDIX III

HEALTH SERVICES FOR MOTHERS AND CHILDREN

Maternity Services

An expectant mother usually, in the first place, consults her family doctor (or general practitioner) and decides with him whether to have her confinement at home or in hospital.

If the mother is to be confined at home she books a general practitioner and a midwife and they cooperate in the prenatal care. In the great majority of cases the midwife conducts the delivery, with the doctor in supervisory attendance, or on call if required, and visiting subsequently for postnatal care. The midwife attends the mother and baby for at least 10 days after the confinement.

Domiciliary consultation with an obstetric specialist is arranged if required. An obstetric emergency team (comprising an obstetrician and an experienced hospital midwife, with a car carrying equipment) is available at the principal maternity hospital in most towns and can be summoned by a general practitioner. It is particularly valuable in cases where urgent treatment is needed before the patient can be moved to hospital.

A mother may obtain the services of a "home helper" to undertake the household work during her lying-in period, and for this a charge is made according to the patient's means.

If the mother is to be confined in a general practitioner maternity unit, arrangements will be made by her doctor and the matron of the unit for their cooperation in prenatal care and for the delivery. A general practitioner maternity unit is a small unit, usually of not more than 25 beds, which is staffed by midwives but has no resident medical staff. Medical responsibility is undertaken by general practitioners.

If a mother is to be confined in hospital, the hospital accepts responsibility for prenatal care, the delivery, and immediate postnatal care which will be carried out by the hospital doctors and midwives under the direction of a consultant obstetrician.

A postnatal stay of 10 to 14 days in hospital has been customary for many years, but this period has become progressively less in recent years, until by 1965, 43 percent of hospital cases were discharged within a week after delivery, due mainly to the need for delivery of more high-risk cases in hospital and the current bed shortage. The expedient is being used of 48-hour discharge in an increasing number of centers.[54] On followup, no apparent detriment has been shown in mother or baby in terms of fatalities or readmissions to hospital.[55] Careful selection must be made of babies suitable for 48-hour discharge and close cooperation with general practitioners and domiciliary midwives is essential. The findings of the British Perinatal Mortality Survey suggest that the proportion of suitable babies may be no higher than 25 percent of all hospital births.

In most hospitals a consultant pediatrician is attached to the maternity unit, cooperating with the obstetricians in prenatal and postnatal care and undertaking the supervision of premature infants and others requiring special care. The concept of a specialist "neonatal pediatrician" has now been introduced successfully in a few areas.

Table I, derived from data in the British Perinatal Mortality Survey in 1958, shows the part played by the various medical and nursing personnel in the actual delivery. It does *not* indicate responsibility for prenatal care and the general supervision of the pregnancy and confinement.

Considering all medical personnel together, doctors delivered just under 14 percent of the total births and were present at the birth in a total of 27 percent. In the births at home, doctors delivered 6 percent and were present at 19 percent of births. A doctor would most probably have seen the patient at some time during labor in a further proportion of home births. In hospital births a doctor would certainly have seen the patient during labor and, if not actually present at birth, would be available within minutes if required.

At actual delivery, a midwife was the senior person present in 80 percent of all births, and this proportion is approximately the same for births in hospital, in general practitioner units, or at home.

A *midwife* is a fully trained state-registered nurse who has taken further training for 1 year in midwifery.

Table I. Percentage distribution of births, by place of delivery according to accoucheur: England, Scotland, and Wales, March 3-9, 1958

Accoucheur	All births	Place of delivery		
		Hospital	General practitioner unit	Home
	Percentage distribution			
Total-----	100	100	100	100
Consultant or registrar------	6	10	2	-
House officer---	3	6	-	-
General practitioner---	4	1	11	6
Midwife---------	53	34	78	70
Pupil midwife or medical student--------	32	48	8	20
No trained person present-	2	-	-	4

After passing the examinations of the Central Midwives Board, she is entitled to the designation "State Certified Midwife."

The practice of midwifery is strictly governed by the rules of the Central Midwives Board which, among other things, make it obligatory for a midwife, when practicing on her own responsibility, to call for medical aid for any abnormality during pregnancy, labor, or the puerperium.

A midwife may, on her own responsibility, administer simple sedatives, e.g., bromides and chloral hydrate, and also certain other drugs, e.g., pethidine (meperidene) and ergometrine (ergonovine maleate), provided she has received instruction in the use of such drugs. She may also, with the same proviso, supervise the patient's use of self-administered analgesia, e.g., nitrous oxide and air. She may not, on her own responsibility, administer anesthesia. She may perform an episiotomy but must summon medical aid for the repair of an episiotomy or a perineal laceration. She may not undertake any instrumental delivery.

Pediatric and Child Health Services

After the mother's discharge from hospital, or after the midwife ceases attending her at home, she is visited by a health visitor who continues to visit the home until the child reaches school age.

A *health visitor* is a fully trained state-registered nurse who has also taken a short course in midwifery and 9 months' training in the public health and medico-social aspects of nursing (especially in relation to mothers and children) leading to the examination for the Health Visitor Certificate.

Health visitors' principal duties are advising mothers and supervising the progress of young children, by visiting homes and child welfare clinics. With the inception of the National Health Service their duties were widened to include health educational work for the whole family. In recent years they have been working increasingly in cooperation with general practitioners.

When the child is a few weeks old most mothers commence attending their local maternity and child welfare center. These centers are provided by local authorities and staffed by medical officers, health visitors, and midwives. Their function is to provide advice and supervision of the child's health (physical, mental, and emotional) at routine child welfare sessions and also special activities such as mothercraft, prenatal exercise classes, immunization, dental clinics, screening tests for deafness, and special supervision of handicapped children. Treatment is not normally undertaken except that of a simple and mainly preventive nature. About 80 percent of babies attend a child welfare center.

Under the Welfare Foods Service, expectant and nursing mothers and children under 5 years of age can obtain a pint of milk per day at a reduced price from their usual dairyman by means of tokens supplied by the Ministry of Pensions and National Insurance. Other welfare foods can be obtained at maternity and child welfare centers. These are dried milk (as an alternative to liquid milk and at an equivalent price), orange juice, cod-liver oil, and tablets of vitamins A and D at cost price. Welfare foods can be obtained free of charge in needy cases.

In the event of illness a sick child is usually first seen by the family doctor. If nursing care at home is required he calls on the visiting home nursing service which is provided everywhere by local authorities. If required, the doctor arranges a domiciliary consultation with a pediatric specialist. If hospital care is required the child is admitted to a children's hospital or a children's ward in a general hospital under the care of a consultant pediatrician.

All facilities that have been mentioned, except home help and welfare foods, have been available without charge as part of the National Health Service since its inception in 1948. Alternatively, arrangements can be made for a doctor, either a general practitioner or a consultant, to undertake any of this work on a private fee-paying basis, whether at home, in a private nursing home, or in the private wards of a hospital, but such arrangements are made in only a small number of cases.

In the National Health Service the hospital and general practitioner services are financed and organized nationally, with regional delegation of administration. Home midwifery, home nursing, and the preventive and

educational health services (including welfare centers and health visitors) are financed partly nationally and partly locally and are organized and administered by local government authorities.

National Insurance Benefits

A maternity grant is payable to a mother on the birth of her child, provided she or her husband have fulfilled the conditions regarding insurance contributions. At the 1964 rate of exchange, this grant of £22 was approximately equal to 62 U.S. dollars. Additional grant can be claimed if more than one child is born. A maternity allowance of £ 4 (about $11) per week is payable to a mother who has been employed and who gives up her work because of pregnancy. The allowance is for 18 weeks, beginning 11 weeks before the expected week of the confinement. Family allowances are payable to all parents with more than one child: 8 shillings (about $1.10) per week for the second child and 10 shillings (about $1.40) per week for each subsequent child.

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